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MARKETING PROBLEMS OF THE ARIZONA LUMBER INDUSTRY

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MARKETING PROBLEMS OF THE ARIZONA LUMBER INDUSTRY

by

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A cooperative project by the

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Bryce J. Brisbin

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CHAPTER I

INTRODUCTION

Contrary to the popular belief that Arizona is strictly a desolate, desert state with cactus the primary vegetation, the largest continuous stand of ponderosa pine in the United States is located in Arizona. While Arizona is not considered a principal lumber producing state, the forest resource provides the raw material for a forest products industry that produces over one-third of a billion board feet of lumber each year.[1] As measured by the economic concept of value added, the production of lumber is an important contributor to the state's economy and the industry is one of Arizona's major manufacturing employers.

It is common to speak of the forest products industry at the primary manufacturing level as consisting of three principal divisions: the lumber producing or sawmill industry, the pulp and paper industry, and the veneer and plywood industry. Arizona's paper industry is in its infancy and at the present time there is no plywood production in the state. This study is concerned, there-

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[1]John S. Spencer, Jr., Arizona's Forests, U. S. Forest Service Resource Bulletin INT-6 (Ogden, Utah: U. S. Air Force Printing Plant, 1966), p. 27.

fore, only with the lumber manufacturing industry in Arizona.

The lumber industry, both nationally and in Arizona, has not experienced growth in its markets commensurate with the expansion of the American economy. Per capita consumption of lumber has declined from about 468 board feet in 1910 to 269 board feet in 1950 and to 200 board feet in 1962. Forest Service projections are for a continuing decline in per capita consumption to 165 board feet in the year 2000.[2] The total consumption of lumber has remained almost static since the beginning of this century (Table 4, Appendix C). Consumption in 1962 was slightly below the mean consumption for the 14-year period of 1948-1962.

The traditional and principal utilization of lumber is in the construction of new buildings and homes and other construction uses. However, the use of lumber per unit of construction, especially residential construction, is declining.[3] This decline is due to several causes, the most important being the rapid increase in the use of panel products (such as plywood) for sheathing, flooring, and forming, and the use of non-wood substitute materials.

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[2]U. S. Forest Service, Timber Trends in the United States, Forest Resource Report No. 17 (Washington: U. S. Government Printing Office, 1965), p. 43.

[3]Stanford Research Institute, America's Demand for Wood, 1929-1975 (Tacoma, Washington: Weyerhaeuser Timber Co., 1954), p. 35.

New construction techniques have also contributed to the decline in lumber use. Growth in the proportionate amount of houses built on concrete slab foundations has reduced the amount of lumber used in foundations and flooring.

The increasing cost of skilled labor has caused builders to shift from lumber to panel products as it is obviously quicker and therefore less expensive to nail a 4 foot by 8 foot panel in place than to handle, saw, and nail in place 6 separate 8 inch boards. J. Alfred Hall, former Director of the Forest Service's Forest Products Laboratory, has said:

> In the housing field I think it is inevitable that the trend should be in the direction of goods available in a form that can be readily and economically assembled into a dwelling. . . . I do not believe we need longer tolerate the present type of house construction in which a carpenter, at $3.50 an hour, will drive 50,000 nails into 2,000 pieces of wood, many of which he has had to saw and shape for a special purpose. The cost is far too high.[4]

Purpose of the study

The purpose of this investigation was to determine what impact the changing patterns in the consumption of lumber have had on the industry in Arizona and to examine what the industry was doing to adapt to the changing market situation. Specifically, the study was designed to test the hypothesis that the markets for Arizona produced lumber

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[4]J. Alfred Hall, "Utilization in Years Ahead," The Next One Hundred Years in Forestry (Corvallis, Oregon: Oregon State College, February, 1959), p. 36.

are changing and that the industry in Arizona is not adapting to these changes.

To test this hypothesis, the study was organized to examine the Arizona lumber industry for recent years in an attempt to discover answers to the following questions: What types and kinds of lumber products were produced and were there any significant changes in the product mix? What types of middlemen purchased Arizona lumber? Were there any changes in the types of buyers? Where were the markets for Arizona lumber located? Were there any important changes in these market locations? How did Arizona lumber producers organize and manage the marketing functions? Were there any significant changes in the performance of the marketing functions?

A secondary objective of the study was to make a preliminary investigation of the opportunities for the production and marketing of possible new primary and secondary products from Arizona's forest resource. As a thorough examination of possible new products would be a complete study in itself, the purpose here is only to suggest selected other new methods of utilizing Arizona timber.

Importance of the study

Although the lumber industry is important to the state of Arizona, very little is known about the marketing

of the products it produces. There is much data published by the Forest Service, the Western Wood Products Association, the National Forest Products Association, and other associations and agencies concerning the resource itself. There are also large quantities of information available about the annual cut and the volume and type of lumber produced, but there has been little systematic investigation into what products have been sold, where they have been sold, or how they have been sold. For example, only one reference in a professional publication was found that gave an estimate of the quantity of Arizona produced lumber exported from the state. This article indicates that about 90 per cent of the lumber produced in Arizona is sold outside of the state;[5] however, this is only an estimate based upon informal investigation (and it did not prove to be an accurate estimate as indicated in Chapter IV).

At the time this research project began (March, 1966), no study had been made, or at least none had been published, that reported upon the marketing of Arizona lumber. In June, 1966, the Western Wood Products Association released a report entitled "Profile of Western Sawmills" that reports some marketing information about sawmills located in the twelve western states (including

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[5]Thomas J. McCleneghan and Frank A. Petroni, "Marketing Arizona's Forest," Arizona Review, Vol. XIV, No. 2 (Tucson, Arizona: Bureau of Business and Public Research, University of Arizona, February, 1965), p. 3.

Arizona) for 1964.[6] Another study sponsored by the United States Department of Agriculture for the year 1962 is currently underway but has not been completed. Neither of these studies duplicates this study.

The situation concerning the lack of knowledge of lumber marketing is not unique to Arizona. In the Preface to his book, Economics of the American Lumber Industry, Joseph Zaremba states:

> The economics of timber growing has received most of the emphasis /in forest economics/. . . . The economics of lumber manufacture, distribution and consumption has been given very little consideration.[7]

From a review of the literature there appears to be a slight increase in the amount of information available in the past 4 or 5 years and a few studies for particular states and one region have been published recently. These are discussed in the section on the review of the literature.

In view of this dearth of information about the marketing of Arizona lumber, it was the opinion of this writer that a study of lumber marketing as practiced by Arizona producers would be of value to lumber producers and marketers, to the Forest Service (the owner of the resource), and to those interested in the study and future

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[6] Statistical Yearbook, 1964-65 (Portland, Oregon: Western Wood Products Association, 1966).

[7] Joseph Zaremba, Economics of the American Lumber Industry (New York: Robert Speller & Sons, 1962), p. viii.

of the lumber industry in Arizona. The Rocky Mountain Forest and Range Experiment Station of the Forest Service is interested in this study and both it and Northern Arizona University have co-operated financially in the support of the study. In addition, excellent co-operation has been given by the lumber producers in the state.

Limitations of the study.--This investigation of the problems involved in the marketing of Arizona lumber was limited to a 7-year period, 1959 through 1965. The study was concerned only with the marketing of lumber produced by mills located in the state. It reports sales by primary manufacturers to the various types of middlemen in the industry; it does not report sales by middlemen to ultimate users and consumers. The report has concentrated on the types and quantities of lumber that have been marketed and does not report the dollar value of lumber shipments. Estimates of the value added by manufacturing and of the total value of lumber sales by Arizona lumber producers are published periodically.

Research methodology

To determine products, markets, and marketing practices of Arizona lumber producers, it was decided that the two best sources of information would be experienced management personnel from producing firms and sales invoices of lumber sales from the mills. Of the 25 active

mills in the state at the time of this study, 12 were selected for inclusion in the study. These 12 mills accounted for over 90 per cent of the total annual production capacity in the state at the time the data were gathered (June-August, 1966).

The research consisted of the collection of information from sales invoices for the period of 1959 through 1965. A 5 per cent probability sampling of all available invoices was made. Interviews with executives of the selected firms were conducted before and after the collection of the data from the sales invoices. Interviews were conducted also with Forest Service personnel and faculty members of the School of Forestry at Northern Arizona University.

As the information obtained from the investigation is strictly proprietary in nature, data is reported only in aggregates for the state and not by individual mill or firm. Every precaution has been taken so as not to disclose any proprietary information about any individual firm. Any information reported about a single mill or group of mills are data available to the public in some publication or is common knowledge.

Review of the literature

As mentioned above, there has been very little written about lumber marketing by Arizona producers. In

general, a search of the literature indicates that very little has been written about lumber marketing on a national scale, although there does appear to be an increase in available information in recent years. One important work is a publication concerning the marketing of lumber by lumber producers in the Northeast.[8] This study reports what types of products have been sold and the location of the markets but it does not investigate marketing management procedures. No other study specifically analyzing lumber marketing and marketing management for a state or a region has been discovered.

There are excellent bibliographies published by the Forestry Schools at Syracuse University and Oregon State University dealing with the broad field of forest economics. A careful search of these bibliographies did not indicate any articles dealing specifically with the marketing management aspects of the lumber industry.

A Forest Industries Management Center has recently been established as part of the School of Business Administration at the University of Oregon to study the management of the firms engaged in harvesting and processing of timber products. The only publications available at this time from the Center dealing with lumber marketing are

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[8]Wallace W. Christensen et. al., Marketing of Lumber Produced by Sawmills in the Northeast--Phase I, West Virginia University Bulletin 478 (Morgantown, West Virginia: Agricultural Experiment Station, 1962).

copies of speeches presented at trade association meetings.

Three significant publications that refer to the extent of the lumber market in the United States are The Economic Importance of Timber in the United States,[9] Timber Resources for America's Future,[10] and Timber Trends in the United States,[11] all three published by the Forest Service. These studies analyze timber-based activities in the United States from the standpoint of the number of firms, value added, employment, and broad breakdowns of products produced. There is no detailed information contained in these studies as to the specific types of products marketed, where they were marketed, or more important, how they were marketed.

Four books have provided excellent background information on the lumber industry. Two of these books, Economics of the American Lumber Industry[12] and Economics of American Forestry,[13] analyze the lumber industry from the traditional economic viewpoint. They provide excellent

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[9]Dwight Hair, The Economic Importance of Timber in the United States, U. S. Forest Service Miscellaneous Publication 941 (Washington: U. S. Government Printing Office, 1963).

[10]U. S. Forest Service, Timber Resources for America's Future, Resource Report No. 14 (Washington: U. S. Government Printing Office, 1958).

[11]Timber Trends in the United States, op. cit.

[12]Zaremba, op. cit.

[13]Albert C. Worrell, Economics of American Forestry (New York: John Wiley & Sons, 1959).

insight into the supply of andthe demand for forest products. The other two books, Western Forest Industry--An Economic Outlook,[14] and Competition and Oligopsony in the Douglas Fir Lumber Industry,[15] provide economic analyses of the forest products industry in the western states. There are other texts and books on forest economics that were referred to but these four provided the writer background information on the economics of the forest products industry.

In addition to the Northeast lumber study mentioned above, there have been a few other studies of certain aspects of the lumber industry with application to given states or regions. The Outlook for Expanding New Mexico's Forest Industries[16] examines the potential for expansion of all segments of the industry in the state and concludes that the most serious problems facing the industry are "the loss of markets and the inability of firms to improve their competitive position."[17] The industry's difficulties

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[14]John A. Guthrie and George R. Armstrong, Western Forest Industry--an Economic Outlook (Baltimore: The Johns Hopkins University Press, 1961).

[15]Walter J. Mead, Competition and Oligopsony in the Douglas Fir Lumber Industry (Berkeley: University of California Press, 1966).

[16]Rudyard B. Goode and Harold W. Corley, The Outlook for Expanding New Mexico's Forest Industries (Albuquerque, New Mexico: Bureau of Business Research, University of New Mexico, for the Small Business Administration, 1964).

[17]Ibid., p. 34.

"are such as to make the outlook for New Mexico's forest industries not very bright."[18]

This study is of special interest as the forest products industry in New Mexico is very similar to Arizona's. The study is not comparable to this one, however, as it relied heavily on secondary data; no primary data were gathered from original source documents. The two studies complement each other and together give a regional view of the lumber industry in the Southwest.

The Western Wood Products Association in its "Profile of Western Sawmills"[19] reports upon some aspects of the marketing of lumber by sawmills in the western states. According to this publication, the information was gathered by a mailed questionnaire. It is doubtful that detailed, specific reponses as to products marketed and quantities shipped to various locations would be obtained through this type of questionnaire.

At the present time, a co-operating group of western land grant universities, through their agricultural experiment stations, are conducting a survey of lumber marketing in the western states for the year 1962; however, this study has not been completed so it is not possible to know what the contents of the report will be. It is presumed it

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[18] Ibid., p. 36.

[19] Statistical Yearbook, op. cit.

will concentrate on products and markets and not on marketing management. Inasmuch as it is for 1962, it is not a duplicate of this study.

In general, the literature is profuse with technical information about timber stands, growth rates, utilization of mill residues, and related technical and production information. There is some information as to markets for lumber and changes in these markets. There is almost no information as to the marketing management procedures practiced by lumber manufacturers.

For general reference purposes many materials were used as indicated in the Bibliography. These references provided valuable background information about the lumber industry.

Definition of terms used

There is a plethora of technical and unique terms used in the lumber industry which has indicated a need for the glossary of technical terms that is contained in Appendix A. A few general terms are defined here that are used throughout the report.

Already referred to is the term forest products industry. In general, forest products industry (or as sometimes used, the wood products industry) is used to designate the general area inclusive of all timber-based economic activities with special emphasis on the harvesting

and the processing phases of the field. The lumber industry as used in this report refers to the segment of the forest products industry that is engaged in the primary manufacture of lumber from the raw material. This will also be referred to as the sawmill industry, the lumber manufacturing industry, or the lumber producing industry. In this sense the veneer and plywood industry and the pulp and paper industry are considered as separate industries or divisions of the forest products field.

Three terms used in the report are explained here as they do not always carry the same connotation in the lumber industry as they do in other usages. The three terms are lumber wholesaler, lumber broker, and retail lumber yard.

Generally speaking, a lumber wholesaler is one that buys from a manufacturer of lumber for resale to a retailer or other large wood-using firm such as an industrial firm or a secondary manufacturer. Frequently the wholesaler does not take physical possession of the product. In this kind of situation the lumber is shipped directly from the mill to the retailer or other final buyer with the wholesaler taking title to, but not taking possession of, the product. The wholesaler bears the financial risk of a sale as he is responsible to the lumber producer for the payment of both the lumber and the freight bill. He in turn collects from the retail yard or other final buyer.

A lumber broker (or as sometimes used, a commission agent) neither takes title to nor possession of the lumber. His primary function is to locate buyers and to arrange shipments from the mill directly to the buyers. He bears no financial risk and does not grant credit to or collect from the final buyer. The broker is paid directly by the lumber producer for his services.

Retailers in the lumber business primarily sell to final users such as builders, contractors, carpenters, cabinet makers, and individual consumers. In some instances they also act as wholesalers selling in large quantities to other business firms. Many large retail lumber yards maintain both wholesale and retail divisions and it was, of course, impossible to tell from the invoices whether the lumber was for the wholesale or retail division.

For classification of the survey data as to type of buyer, the classifications used by the Retail Lumbermen's Credit Association are the ones used in this report.[20]

Organization of the report

Before presenting a detailed examination of lumber marketing in Arizona, a brief introduction to the lumber industry in the United States is presented to provide a

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[20]The Lumbermen's National Red Book Service Reference Book (Chicago: Lumbermen's Credit Association, Inc., published annually).

better perspective from which to view the industry as it operates in Arizona. Chapter II is an overview of the industry in the United States with special emphases upon the forest resource, the economic importance of timber-based activities, the structure of the industry, and the manufacturing process. The first section of the chapter concludes with an examination of the problems facing the industry. The second section presents a brief introduction to the lumber industry in Arizona and indicates problems peculiar to the Arizona industry.

Chapter III is a thorough discussion of the methods used in obtaining the survey data. The procedure utilized in selecting mills included in the study, the sampling technique for the selection of sales invoices, and the methods used for recording and compiling the data are presented in detail. The numbers and types of management personnel interviewed are also presented in this chapter.

The results of the survey as it pertains to the products marketed by Arizona lumber producers are presented in Chapter IV. The chapter contains a discussion of lumber characteristics and methods of designating and identifying types of lumber. Detailed percentage breakdowns of the various types and classifications of Arizona lumber marketed during the sample period are presented. Chapter IV also reports the results of the survey with reference to the types of middlemen purchasing Arizona

lumber and the location of the markets for the lumber. It contains a discussion of the differences between lumber exported from Arizona to other states in comparison to the lumber retained for use within the state.

Chapter V presents a thorough discussion of the performance of the marketing functions by the firms engaged in the production of lumber in Arizona. It examines pricing procedures, sales procedures, the relationship between production and marketing within a firm, advertising and promotion, and the extent of new product research and development activities.

A preliminary evaluation of the potential for new primary products from Arizona pine lumber is contained in Chapter VI. Inasmuch as this could be a complete study in itself, this is only a preliminary investigation of the market potential for and the investment required to manufacture other pine products.

Chapter VII is a summarization of the study, a report of the conclusions reached, and recommendations based upon the conclusions.

The Appendices contain a glossary of technical terms, a list of the sections and regions in the United States as used in this report, additional original and secondary data not contained in the text, a listing of nominal and dressed sizes of lumber, and descriptions of the forest species found in Arizona. The Bibliography

lists resource materials utilized in the preparation of this study.

CHAPTER II

THE LUMBER MANUFACTURING INDUSTRY

The Industry in the United States

The lumber industry in North America is one of the nation's oldest industries with a history dating back to the early seventeenth century when settlers first arrived on the Eastern seaboard of the continent. There is evidence that a sawmill was in operation in Maine as early as 1623 or 1624.[1] By the eighteenth century sawmills were in operation throughout the original colonies and lumbering had become an important industry.

The forests proved to be both a nuisance and a blessing to the early settlers--a nuisance in that the lands had to be cleared so that agricultural crops could be grown and a blessing as the logs were used to make homes and shelters for the pioneers and to provide fuel for heating and cooking. The clearing of the land and the utilization of the wood for construction and fuel continued as the frontier pushed westward across the continent.

During the eighteenth and nineteenth centuries

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[1]Joseph Zaremba, Economics of the American Lumber Industry (New York: Robert Speller & Sons, 1963), p. 14.

loggers clear-cut millions of acres of virgin forest land to provide lumber for the rapidly expanding nation. The early loggers apparently believed that the supply was limitless and little thought was given to the preservation of some of the forests for future use. Certainly no thought was given to the process of selective logging or sustained yield that is practiced by foresters today. Due to the philosophy of "cut and get out," millions of acres of virgin forests were devastated in the New England states, the Lake states, and the South.[2]

Early explorers and settlers arriving in the Pacific Northwest found one of the world's outstanding stands of timber. The clearing of the land for agricultural purposes and the use of the wood for shelter and fuel followed the usual pattern of the new frontier. To meet the demand for lumber for construction purposes, a sawmill industry rapidly developed as it had in the East. By 1849, thirty sawmills were operating in Oregon. Thomas Vaughan, Director of the Oregon Historical Society, has said:

> By the time of the great California gold strikes, thirty mills were operating in Oregon. Prior to California gold reports, lumber sold at $30.00 per thousand in Oregon mills. By November, 1849, increasing demands for lumber drove prices to $80 per thousand and in 1850 to $100 per thousand.[3]

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[2]Progress in Private Forestry in the United States (Washington: American Forest Products Industries, 1961), p. 3.

[3]Thomas Vaughan, "Forestry and Forest Industries in

The great influx of pioneers to the Northwest created a new demand for sawed lumber for home building. It is estimated that 75,000,000 board feet of lumber was produced in Oregon in 1869.[4] By 1880, the federal census indicated that 265 sawmills were in operation in Oregon and Washington with a total annual capacity of 500,000,000 board feet.[5]

The first decade of the present century was the greatest for the lumber industry with up to 45 billion board feet of lumber being produced in one year.[6] This level of production has not been surpassed and rarely equalled since that time. It was at this time that forestry began to develop into a profession and the revolutionary idea of growing timber as a crop had its genesis. Since that time thousands of professional foresters have been trained and tree farms and other reforestation and forest management techniques have been instituted and have become widespread throughout the timber producing areas of the United States.[7]

Oregon," The Next One Hundred Years in Forestry (Corvallis, Oregon: Oregon State College, 1959), p. 7.

[4]Ibid. [5]Ibid.

[6]Dwight Hair, The Economic Importance of Timber in the United States, U. S. Forest Service Miscellaneous Publication 941 (Washington: U. S. Government Printing Office, 1963), p. 36.

[7]Progress in Private Forestry, op. cit., pp. 10-11.

The forest resource

As indicated above, the forest resource has been used extensively throughout the nation's history. Fortunately for the nation, the virgin forests were so extensive that forests still cover one-third of the 2.3 billion acres of land in the 50 states. However, commercial forest land only accounts for about two-thirds of the total forest area, some 509,000,000 acres in 1963.[8] Commercial forest land is that land that is suitable for and utilized in "the growing of continuous crops of saw logs or other industrial timber products."[9] A detailed discussion of the extent of the resource is presented below.

Timber as an agricultural crop.--In terms of value, logs and related wood products rank as one of the most important agricultural crops in the country. It may be surprising to some to think of timber as an agricultural product; however, it is a renewable resource that can be sown, nurtured, and managed as are other agricultural crops. Adding significance to the fact that forestry is an agricultural industry is that the Forest Service, which is responsible for the management of millions of acres in our national forests, is a part of the United

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[8]U. S. Forest Service, Timber Trends in the United States, Forest Resource Report No. 17 (Washington: U. S. Government Printing Office, 1965), p. 75.

[9]Ibid.

States Department of Agriculture.

In 1958, the value of all timber harvested was equal to 14 per cent of the value of all farm crops harvested, was about equal to the value of the wheat harvest, and was 40 per cent greater than the value of the cotton harvest. Corn was the only farm crop whose value exceeded that of the timber harvest.[10]

Timber is a unique raw material. Under proper management it is not exhaustible as are such raw materials as ores and petroleum, nor is it immediately replenishable such as cotton, wool, tobacco, et cetera. With modern techniques known to professional foresters, the resource not only can be reproduced, it can be improved so that the resulting product is of higher quality. However, the process is a very slow one; it takes many decades before improved saw logs can be harvested from managed timber stands. Most young growth timber being harvested today is a result of natural reforestation processes; very few stands have been subjected to intensive forest management.

The unique aspect of the growing of timber as a crop is the length of the growing period. Depending upon the species and the locality, the growing period ranges from some 40 years to 100 years or more. Obviously, this requires extremely long-range planning on the part

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[10]Hair, op. cit., p. 9.

of firms engaged in the management of forest lands and the production of forest products.

Through silvicultural practices and selective logging techniques, forests can be managed on a sustained yield basis so as to provide continuously raw material for the wood using industries. This means, however, that there are limitations upon the amount of raw material that is available at any one time. To follow the "cut and get out" practice of earlier decades could mean an early end to the forest products industry and the nation would have to substitute other materials for wood.

Extent of the resource.--Forests are classified as softwood forests and as hardwood forests. Generally, the softwoods are those species commonly referred to as conifers and have needle or scale-like leaves. Hardwoods have broad leaves and are usually deciduous in nature.[11]

Softwood forests account for about 80 per cent of the total sawtimber volume of 1,648 billion board feet in the United States. About 85 per cent of the softwood volume occurs in the West and in Alaska. There is little

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[11] Forest Products Industry Facts 1966 (Washington, D. C.: National Forest Products Association), p. 5. "Softwoods and hardwoods--Softwoods are coniferous trees, usually evergreen, having needle or scalelike leaves; hardwoods are dicotyledonous trees, usually broadleaved and deciduous. The distinction is botanical, and some 'hardwoods,' like balsa, are actually very soft. Some major softwoods are the various pines, fir, hemlock and spruce; examples of important hardwoods are oak, maple, poplar, hickory, and walnut."

commercial hardwood available in the West, 93 per cent of the total volume being located in the eastern part of the country.[12] Five species, Douglas-fir, ponderosa pine, western hemlock and Sitka spruce, the western true firs, and southern yellow pine, account for 64 per cent of the total of all live sawtimber (Table 1).

TABLE 1. Sawtimber species as per cent of total sawtimber.

Species	Per cent
Douglas-fir	26
Ponderosa and Jeffrey pine	11
Western hemlock & Sitka spruce	10
Western true firs	9
Southern yellow pines	8
All other sawtimber species	36
Total	100

Source: U. S. Forest Service, Timber Resources for America's Future, Forest Resource Report No. 14 (Washington: U. S. Government Printing Office, 1958), p. 40.

The comprehensive report, Timber Resources for America's Future,[13] and the more recent, Timber Trends in the United States,[14] indicate that the amount of commercial forest land continues to increase. Most of the increase in recent years has occurred in the South where acreage has

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[12]U. S. Forest Service, Timber Resources for America's Future, Forest Resource Report No. 14 (Washington: U. S. Government Printing Office, 1958), p. 39.

[13]Ibid.

[14]Timber Trends in the United States, op. cit.

increased some 6.7 million acres.[15] Overall, there was a net increase of 1.5 per cent in commercial forest land during the decade of 1953 to 1963.

Although this trend appears favorable, the increase in the timber supply situation is not so favorable. According to Timber Trends in the United States:

> Much of the land lost to timber growing is of relatively high timber growing capability, and often the timber standing on such land is not utilized. Most areas reverting to forest, on the other hand, are wornout farmlands that must be restocked either artificially or naturally before they can produce timber crops at some future date.[16]

One of the serious problems facing the industry is that the quality of saw logs is deteriorating. As virgin timber has been removed from the most favorable areas, operators have been forced to log poorer and more inaccessible stands and in some areas, young-growth timber. The resulting logs are smaller and of generally poorer quality than was available in past years.

The Forest Service report foresees an adequate growth-cut relationship for the next two or three decades. Depending upon many unpredictable variables, it is believed the growth will exceed the quantity harvested during the next 20 years. After that the demand for wood could cause the cut to exceed the growth some 7 billion board feet of sawtimber a year.[17] The long-range future of the industry

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[15] Ibid., p. 78. [16] Ibid. [17] Ibid., p. 137.

will depend upon improved production technology, better utilization of the log, and more intensive forest management. Foreign imports will undoubtedly supply a larger share of the total lumber available for consumption.

Obviously, it is of great importance to the industry to provide for an adequate supply of timber for continued operation. The Forest Service report sounds a general alarm for the industry in its concluding paragraph:

> With continued growth in numbers of people and economic output beyond the year 2000, the estimates of timber demands projected in this study may in time seem modest indeed. A long lead time is necessary in timber production. Hence judgments regarding such longer range market possibilities and prospective timber supply problems also must be considered in the formulation of today's forestry programs.[18]

Ownership of forest land.--There are 758,865,000 acres of forest land in the 50 states of which 67 per cent or 508,845,000 acres are classed as commercial forest land.[19] The ownership of this commercial land is shown in Table 2. Of the total commercial forest land, 72 per cent is privately owned. However, only about 13 per cent is owned by the wood-using industries. The picture changes drastically in the 14 western states where only 32 per cent of the commercial forest acreage is under private ownership with the forest products industry owning only 11 per cent of the total. In Arizona, over 95 per cent of the forest land is publicly owned (see Table 12,

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[18] Ibid. [19] Ibid., p. 141.

TABLE 2. Area of commercial forest land in the United States by ownership and region, January 1, 1963 (in thousand of acres).

Region	All Ownership	Federal	State	County & Municipal	Forest Industry	Farmer	Misc. Private
Total North	171,789	12,508	12,751	6,748	14,316	55,503	69,963
% of Total	100.0	7.3	7.4	3.9	8.3	32.4	40.7
Total South	201,069	14,062	2,164	656	37,422	78,897	67,868
% of Total	100.0	7.0	1.1	0.3	18.6	39.2	33.8
Total West	135,987	86,606	5,929	444	14,890	16,617	11,501
% of Total	100.0	63.7	4.4	0.3	10.9	12.2	8.5
Total All Regions . . .	508,845	113,176	20,844	7,848	66,628	151,017	149,332
Per cent	100.0	22.2	4.1	1.5	13.1	29.7	29.4

Source: U. S. Forest Service, Timber Trends in the United States, Forest Resource Report No. 17 (Washington: U. S. Government Printing Office, 1965), pp. 141-42.

p. 63).

Public ownership of the basic material poses serious management problems for firms in the industry. Lands located on national forests (56 per cent of all commercial forest land in the west) have to be managed under a multiple-use concept. While logging is an important use of the forest, recreation, wildlife habitation, livestock grazing, and watershed management are also important uses of forest lands. These uses must be considered by the public agencies in granting cutting permits to logging firms. Timber on the national forests must be negotiated for or bid on at public auctions and must be logged under Forest Service regulations and supervision.

The major lumber producing states, such as Oregon, Washington, and California, where private ownership is a larger share of the total forest lands, do not have as severe a problem in this respect as do Arizona, Utah, and New Mexico. These latter states have a relative high proportion of publicly-owned forest land.

There is no intention or reason in this study to delve deeply into the problems involved in the ownership of the raw material. Suffice it to say that public ownership of the timber limits the freedom of choice of entrepreneurs in the industry.

Economic importance of lumber

It is difficult to measure precisely the lumber industry's contribution to the nation's economy as specific data, limited to but also inclusive of all segments of the industry, are difficult to derive from published sources. In July, 1963, the U. S. Forest Service released a study, The Economic Importance of Timber in the United States,[20] which evaluates the contribution of timber-based economic activities to the nation's economy for the years of 1954 and 1958. Although it is somewhat out of date, it is the best report available and it is indicative of the importance of the wood using industries to the nation's economy.

Value added and employment.--The Forest Service report indicates that on the basis of the economic concept of value added, the timber resource increased in value about 25 times during the harvesting, manufacturing, and

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[20]Hair, op. cit. To prepare this report was an exceedingly involved task as it required both the combination of and the separation of many standard economic time series so that the final data would be representative of all timber-based economic activity. The bases of these data are stated on page 1: "All of the values added and the employment of forest management and harvesting activities, as defined in this report, were considered to be timber-based and thus were attributed to timber. However, in the enterprises engaged in manufacturing, fabrication, construction, transportation, and trade where both timber and non-timber materials were used or handled, only portions of the total value added and the employment were attributed to timber. . . . The sum of the values added and employment attributed to timber is considered to represent that part of the gross national product and national employment originating in timber-based economic activities."

distribution processes in the year 1958. The report also indicates that the value added in 1958 amounted to about 25 billion dollars, 5.6 per cent of the gross national product for that year (Table 3).

TABLE 3. Estimated total value added and employment attributed to timber in timber-based economic activities in the United States, 1958.

Kind of Timber-based Economic Activity	Value Added		Employment	
	Millions of Dollars	Per Cent	Thousands	Per Cent
Forest Management	998	4.0	82	2.5
Harvesting	1,509	6.1	342	10.3
Primary Manufacturing	3,856	15.6	489	14.7
Secondary Manufacturing	5,446	22.0	793	23.9
Construction	7,610	30.8	840	25.2
Transportation and Marketing	5,336	21.5	776	23.4
Total	24,755	100.0	3,322	100.0

Source: Dwight Hair, The Economic Importance of Timber in the United States, U. S. Forest Service Miscellaneous Publication 941 (Washington: U. S. Government Printing Office, 1963), p. 3.

In addition to the value added data, another important statistic is the number of persons employed. The timber-based industries employed over 3.3 million people in 1958, over 5 per cent of the total non-agricultural employment in the United States (Table 3). These data indicate that timber-based economic activity is a signifi-

cant contributor to the nation's economy.

It is interesting to note from Table 3 the contribution to the total value added by the various segments or functions of the industry. While primary manufacturing accounted for only 15 per cent of total employment, 23 per cent of the employment was in the area of transportation and marketing and this area accounted for 21.5 per cent of the total value added.

Guthrie and Armstrong present an interesting historical study of the value added and the number of employees in the industry going back to 1929 (Table 4). This study is significant as it shows lumber's relative contribution (as measured by value added) is decreasing while the pulp and paper industry and the plywood and veneer industry are increasing. This problem will be discussed below in the section dealing with problems facing the industry.

Lumber consumption.--The surprising aspect of the history of the lumber industry is that there has not been any long-term trend, either up or down, in lumber consumption since 1900. With the exception of the Great Depression years (1931-1939), the consumption of lumber has not varied more than 6 billion board feet from the mean annual consumption of 38.24 billion board feet since 1900.[21] Con-

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[21]Data for years 1900-1952: Timber Resources for America's Future, op. cit., p. 419. Data for years 1953-1962: Timber Trends in the United States, op. cit., p. 42.

TABLE 4. Value added by manufacture and numbers of production workers in the lumber, pulp and paper, and plywood and veneer industries for the United States for selected years.

Year	Industry	Value Added by Manufacture: Millions of Dollars	Value Added by Manufacture: Per Cent	Production Workers: Thousands	Production Workers: Per Cent
1954	Lumber	$1,502.9	36.6	296.1	56.2
	Pulp, paper & board	2,289.3	55.9	183.0	34.7
	Plywood & veneer	305.5	7.5	47.9	9.1
	Total	$4,097.7	100.0	527.0	100.0
1947	Lumber	$1,476.5	47.2	363.7	63.6
	Pulp, paper & board	1,466.0	46.9	174.1	30.4
	Plywood & veneer	182.9[c]	5.9	34.2[c]	6.0
	Total	$3,125.4	100.0	572.0	100.0
1939	Lumber	$ 412.9[a]	45.1	265.2[a]	64.2
	Pulp, paper & board	482.9	52.6	137.4	33.4
	Plywood & veneer	20.6[b]	2.3	9.8[b]	2.4
	Total	$ 916.4	100.0	412.4	100.0
1929	Lumber	$ 853.9[a]	68.5	419.1[a]	80.4
	Pulp, paper & board	392.6	31.5	103.3	19.6
	Plywood & veneer	n.a.	-	n.a.	-
	Total	$1,246.5	100.0	522.4	100.0

[a]Includes figures for veneer and shingle mills.

[b]Plywood only. [c]Figures for veneer estimated.

n.a.: not available

Source: John A. Guthrie and George R. Armstrong, Western Forest Industry, an Economic Outlook (Baltimore: Johns Hopkins Press, 1961), p. 4.

sumption in 1962 was 37.3 billion board feet, 3.6 per cent above the mean annual consumption for the 63-year period.[22]

Forest Service projections for the next 40 years are for a continued decline in the amount of wood used per unit of construction, but due to the anticipated increase in the demand for dwellings and other construction needs, there should be an increase in the demand for lumber through the year 2000 (Table 5). An increasing share of future consumption will probably be supplied by foreign imports. However, domestic production must increase to meet the constantly increasing demand. If it cannot expand, it is obvious that additional substitute materials will be relied upon by the construction industry.

Structure of the industry

Among the major industries in the United States, the lumber industry is one of the very few that approximates the classical concept of competition. There are numerous firms, entry into the industry is easy (at least on a limited scale), there is no one large firm or group of a few large firms that together produce enough output to influence lumber prices, and the product is homogeneous. It is estimated that there are as many as 40,000 lumber producers in the United States at the present time. In 1947, 1,104 of the largest firms represented about 50 per

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[22] Ibid.

cent of the total lumber output.[23] A Congressional report shown in Table 6 indicates the great difference in the competitive structure of the lumber industry as compared to other basic industries. This lack of concentration in the industry is believed to have remained about the same to the present time.

TABLE 5. Lumber consumption, net imports, and domestic production, 1920-2000 (billion board feet), all species.

Year	Consumption	Net Imports[a]	Domestic Production
1920	34.7	(0.3)	35.0
1930	28.1	(1.2)	29.3
1940	31.0	(0.2)	31.2
1950	40.9	2.9	38.0
1960	36.0	3.1	32.9
1962	37.3	4.1	33.2
	PROJECTIONS		
1970	39.7	5.1	34.6
1980	43.4	5.8	37.6
1990	48.0	6.5	41.5
2000	53.5	7.0	46.5

[a]Figures in parentheses are net exports.

Source: U. S. Forest Service, Timber Trends in the United States, Forest Resource Report No. 17 (Washington: U. S. Government Printing Office, 1965), p. 42.

[23]Zaremba, op. cit., p. 18.

TABLE 6. Concentration of output in largest manufacturing companies for selected industries, 1954.

Industry Title	Per cent of Output Produced by		
	4 Largest Companies	8 Largest Companies	20 Largest Companies
Primary aluminum	100	-	-
Cigarettes	82	99	100
Motor vehicles & parts	75	80	87
Steel works & rolling mills	54	70	85
Motors & generators	50	59	75
Petroleum	33	56	84
Pulp mills	29	42	61
Machine tools	19	29	52
Plywood plants	17	25	42
Men's & boys' clothing	13	21	33
Logging camps & contractors	8	13	20
SAWMILLS & PLANING MILLS	7	11	18
Dresses, unit price	4	7	12
Women's suits, coats & skirts	3	6	11

Source: U. S. 85th Congress, Concentration in American Industry, prepared at the request of the Subcommittee on Antitrust and Monopoly of the Senate Judiciary Committee, Senate Resolution 57, 1957, as cited in Joseph Zaremba, Economics of the American Lumber Industry (New York: Robert Speller & Sons, 1963), p. 19.

The industry is also characterized by an end product that is primarily considered a commodity; in other words, the end product is undifferentiated and it is not possible to identify the producer from observation of the product. There have been attempts to differentiate products by various branding procedures. There is no evidence that this has been of significant success to date. This

problem will be discussed in Chapter V.

Lumber is graded according to grading procedures established by one or more of the trade associations. In the West, the grades are established by the Western Wood Products Asscociation and they conform to the American Lumber Standards.[24] Under these grading procedures, a board graded as No. 2 Common would be of the same quality regardless of the producer of the board. All members of the Association, which includes all of the large mills, most of the medium-sized mills, and some of the small producers, follow these grading standards and their graders are either furnished by the Association or are trained and certified by the Association.

Across the country, not all mills use or adhere to the grading standards. In a study of lumber marketing in the Northeast, it was discovered that only 40 per cent of the softwood and 80 per cent of the hardwood lumber was sold on a graded basis.[25] This contrasts sharply with the practice in Arizona (as indicated in Chapter IV) where practically all of the lumber is sold on a graded basis.

Another distinguishing characteristic of the struc-

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[24] Standard Grading Rules (Portland, Oregon: Western Wood Products Association, 1965).

[25] Wallace W. Christensen et. al., Marketing of Lumber Produced by Sawmills in the Northeast--Phase I, West Virginia University Bulletin 478 (Morgantown, West Virginia: Agricultural Experiment Station, 1962).

ture of the industry is the ownership of the raw material. As discussed above, a large proportion of the raw material is not owned by the producing firms. In general, the larger firms more typically own part or all of their timber resources, whereas, medium-size and smaller firms are dependent to a great extent upon the procurement of logs from other sources.

Trade associations.--There are numerous local, regional, and national trade associations in the lumber industry. Typically, trade associations attempt to assist their members by promoting the use of the product, by gathering data and publishing reports, by conducting meetings to inform members of new technology, and by establishing standards and procedures for the betterment of the industry. The trade associations in the lumber industry follow this general pattern. However, the number of participants in these associations has not been large. Zaremba estimates that only 1,250 lumber producers out of an estimated 40,000 belong to a trade association.[26] Zaremba makes a major point of the need for the strengthening of trade associations and increasing the participation of mills in them.

As this is a competitive industry with most of the firms of small size and limited resources, it is not eco-

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[26]Zaremba, op. cit., p. 7.

nomically feasible for individual mills to engage in research, development, and promotional activities to any extent. It is estimated that only about 0.12 per cent of total product value is spent by the entire industry on research and development activities compared to about 1 per cent by lumber's competitors.[27] This investment in research was made almost entirely by a few of the large firms in the industry. Most firms have depended upon the Forest Service, universities, and trade associations for research and technological improvements.

Vertical integration and diversifications.--There are no data available that indicate the extent of vertical or horizontal integration in the lumber industry. The industry is a very heterogeneous one, made up of all types of firms. The reason that the exact number of sawmills or sawmill firms is difficult to determine is that, first, as a segment of a larger industry, data for the lumber industry is normally intermingled with statistics for other facets of the forest products industry and it is difficult to extract only that data pertaining to the lumber industry. Secondly, there is a vast variation in the degree to which these firms are diversified, some firms operating only sawmills, purchasing their timber supplies from independent logging contractors; other mills own and operate

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[27] Ibid., p. 193.

both the logging operations and the sawmill operations. Some mills produce only rough lumber as they do not have planing facilities. Other firms operate only planing mills for the conversion of rough lumber to surfaced or dressed lumber. Many mills consider the planing operation an integral part of the sawmill operation and generally do not distinguish between the two.

The Standard Industrial Classification confuses the situation by including sawmills and planing mills in the same category.[28] Planing could be considered a secondary manufacturing process rather than part of the primary process as it further refines the product of the sawmill. Normally, however, planing is considered to be a part of the primary process as it is essential to the production of softwood lumber that is in a useable condition for most purposes. In general, most softwood lumber is surfaced and most hardwood lumber is left in an unsurfaced condition. This, of course, is due to the differing end

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[28]Hair, op. cit., p. 83. The Standard Industrial Classification four digit code (2421) is: Sawmills and Planing Mills, General. Establishments primarily engaged in sawing rough lumber and timber form logs and bolts, or resawing cants and flitches into lumber, including box lumber and softwood cut stock; planing mills combined with sawmills; and separately operated planing mills which are engaged primarily in producing surfaced lumber and standard workings or patterns of lumber. This industry includes establishments primarily engaged in sawing lath and railroad ties, and in producing tobacco hogshead stock and snow fence lath. (1958 edition) In addition to this code, there is a classification of "Special Product Sawmills" (code 2429).

uses of the product.

A further complication to the interpretation of available data is that many firms produce other wood products in addition to lumber. Many of the lumber producers also produce such items as posts, poles, and pilings, shingles and shakes, veneer and plywood, et cetera. To obtain data from secondary sources that is restricted to but inclusive of lumber production and marketing is virtually impossible.

There is evidence that vertical integration is common in the lumber industry with the medium-sized and larger firms engaged in activities ranging from timber harvesting through to the retailing of the finished product in company-owned and operated retail lumber yards. It is also evident that there are many larger firms that practice diversified horizontal integration.[29] Worrell uses this term to refer to the production of two or more primary products (such as lumber and plywood) or the processing of waste materials from primary manufacturing into products (such as particle board). Many larger firms engage in all three primary manufacturing areas of the forest products industry, producing and marketing lumber, plywood, and paper products. These firms are also frequently vertically integrated to a large extent, even to owning of their timber resources.

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[29]Albert C. Worrell, Economics of American Forestry (New York: John Wiley & Sons, 1959), pp. 164-66.

The great majority of the firms in the lumber industry, however, are small and it is not evident that they are either vertically integrated or diversified to any great extent.[30] If they are, it usually is in the area of closely related activities such as logging or the preservative treatment of poles and pilings, or similar activities.

Lumber production

At this point some discussion of the lumber manufacturing process is in order to provide the reader with a brief sketch of a sawmill operation. Viewed in the abstract, a sawmill's economics are easily understood. A selected mix of inputs is purchased with which various outputs can be obtained and sold or otherwise disposed of. The inputs consist of logs and other inputs common to any manufacturing process: capital equipment, labor services, management services, power, and other materials.

The primary output is lumber which accounts for only about 50 to 60 per cent of the wood content of the logs fed into the manufacturing process. Of the remaining original wood content, about one-fourth is accounted for by bulk mill residues (such as slabs, edgings, and trimmings) and the remaining portion is in fine mill residues (sawdust and shavings). In the past, most of the mill

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[30] Ibid.

residue was burned at the mill in order to dispose of it. In many cases, the heat was used to generate power to operate the plant or for sale. However, much of the residue was burned without any attempt to use the resulting heat. In either situation, there are costs, both capital and labor, involved in the operation of a waste burner.

There have been significant changes in the utilization of the log in recent years. Waste burners are rapidly disappearing from the scene as mill residue is being recovered for other uses. The main use for much of the bulk or coarse residue today is as raw material for pulp mills. The pulp producing process requires that the wood chips be free of bark and other foreign matter. This requires the installation of a debarker to strip the log of all bark prior to its being sawn. The slabs and edgings from the debarked lumber have to be convered to chips before delivery to the pulp mill. The installation of a chipper is necessary for this operation. The investment in this additional equipment is sizeable with an estimated cost of $125,000 to $250,000.[31] As transportation is costly, the sawmill must be within an economical shipping distance of a pulp mill to be able to utilize its bulk

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[31]Clarence W. Nelson, The Timber Economy of the Ninth District West, Federal Reserve Bank of Minneapolis Special Research Report (Minneapolis: Federal Reserve Bank of Minneapolis, Ninth Federal Reserve District, 1963), p. 27.

waste in this fashion. Fine residue (sawdust) is more difficult to use though some processes are being developed that make use of the finer material.

The lumber production process is a good example of a flow process. After delivery to the mill, the log is debarked (if the chips are to be used for pulp) and advanced to the headrig. The head sawyer operates the headrig which can be either a band saw or a circular saw. He is a key man in the production process as he must determine from brief observation of the log into what types of lumber the log should be sawed. These rapid decisions about how to cut the log are critical in obtaining the highest value lumber from the log. From the headrig, the rough sawed boards go to edgers and trimmers to be squared-off in cross section and cut to standard lengths. The lumber moves from the trimmers along a green chain where boards are drawn off according to grade, size, and species. Lumber to be dried is then stacked for yard drying or, more commonly, kiln drying. The lumber that is to be surfaced is run through the planer after drying and, on occasion, through the re-saw. The re-sawing operation cuts a thicker board into two thinner boards. If the board had been surfaced prior to the re-sawing operation, the resulting lumber would then be surfaced on one side and rough on the other. This type of board in the lower grades is utilized for sheathing and other structural uses.

After the drying process, the lumber is stacked in sheds or in the yard to await sale. Varying degrees of protection must be afforded the lumber depending upon weather conditions, species and grade of the lumber, and length of time it must be stored prior to shipment.

Problems facing the industry

Much has already been said concerning the plight of the lumber industry today. It is obvious that the industry has not shared in the tremendous expansion of the nation's economy that has occurred in this century. In terms of output, the industry is about where it was at the start of the twentieth century.

The most serious problems are posed by the decreasing per capita consumption and the changing uses of lumber. Per capita consumption of lumber has declined from about 468 board feet in 1910 to 200 board feet in 1962 as shown in Table 7. Forest Service projections are for a continuing decline in per capita consumption to 191 board feet in 1970, 180 in 1980, 171 in 1990, and 165 in the year 2000.[32]

The traditional and principal utilization of lumber is in the construction of new buildings and homes and other construction uses. Table 8 shows that about 74 per cent of all lumber was utilized in construction in 1962. However, the use of lumber in construction, especially resi-

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[32] Timber Trends, op. cit., p. 43.

dential construction, is declining (Table 9). The most

TABLE 7. Lumber consumption in the United States, 1910-1962.

Year	Consumption in Billion Board Feet	Per Capita Consumption in Board Feet
1910	43.2	468
1920	34.7	326
1930	28.2	229
1940	30.9	234
1950	40.9	269
1955	40.1	242
1960	36.0	199
1962	37.3	200

Source: Dwight Hair and Alice H. Ulrich, The Demand and Price Situation for Forest Products - 1964, U. S. Forest Service Miscellaneous Publication No. 983 (Washington: U. S. Government Printing Office, 1964), p. 36.

recent estimate is that 8,700 board feet of lumber was used per dwelling in 1962 for all types of residential construction.[33] This same source indicates that projections are for a continuing decline to 7,570 board feet per unit in 1980 and to 7,110 by the year 2000.

The Stanford Research Institute's study (Table 9) indicates the most serious problem: a sharp decline in the utilization of lumber in residential construction. The use of substitute materials and different construction techniques are a major threat to the lumber industry.

[33] Timber Trends, op. cit., p. 19.

Much of the competition comes from within the forest products industry itself as an increasing proportion of the available timber is being utilized to produce panel products and paper-board that compete directly with lumber in many applications. This competition in end use products also causes competition for the raw material, putting upward pressure on the cost of stumpage.

TABLE 8. Lumber consumption in the United States by end use, 1962.

End Use	Million Board Feet	Per cent
Construction		
Residential	13,960	37.4
Non-residential	5,000	13.4
Upkeep and improvements	5,400	14.5
Farming	2,000	5.4
Railroads	940	2.5
Mining	330	0.9
	27,630	74.1
Manufactured products	4,240	11.4
Shipping and materials handling	4,340	11.6
Miscellaneous and residual	1,090	2.9
Total Use	37,300	100.0

Source: U. S. Forest Service, Timber Trends in the United States, Forest Resource Report No. 17 (Washington: U. S. Government Printing Office, 1965), p. 41.

TABLE 9. Estimates of lumber use per dwelling unit by house components, selected years 1920-53, in board feet per unit.

Component	1920	1930	1940	1950	1953
Foundations	1,700	1,350	1,300	1,100	900
Floors	4,300	3,700	3,300	2,550	1,950
Ceilings	975	825	800	750	800
Roofs	2,800	2,250	2,550	2,600	2,400
Exterior walls	2,500	2,350	2,100	1,750	1,600
Interior walls	2,950	2,300	1,700	1,500	1,500
Millwork	2,600	1,950	1,400	1,050	950
Accessories	1,075	675	750	400	400
Total	18,900	15,400	13,900	11,700	10,500

Source: Stanford Research Institute, America's Demand for Wood, 1929-1975 (Tacoma, Washington: Weyerhaeuser Timber Co., 1954), p. 35.

New non-residential construction is also a large user of lumber, mostly in a facilitating role such as forming for concrete, scaffolding, bracing, et cetera. As in residential construction, there has also been a decline in the utilization of lumber in the non-residential construction field from 5.4 billion board feet in 1952 to 5 billion board feet in 1962.[34] During this same period there was a rapid increase in the consumption of plywood in non-residential construction from 135 million square feet in 1952 to 2.8 billion square feet in 1962.[35]

There have been technological improvements in the

[34] Ibid., p. 24. [35] Ibid., p. 24.

production process but, due to the type of raw material, automation of production has not been adopted by the industry. As there have to be many quick decisions as to how best to saw a log and properly trim and rip a board, the industry has not been able to automatize many of the operations. Perhaps optical scanning devices connected with computers can be developed to eliminate the human decisions that are now relied upon to produce lumber.

Most of the technological improvements to date have been in better and more efficient headrigs, trimmers, edgers, et cetera, that reduce residue and speed the operation. These improvements have resulted in economies of operation and productivity has increased (although not as much as in other industries).[36] However, economies that have resulted from technological improvements have been largely offset by increased costs in raw material procurement. Old growth timber is declining and it is becoming more costly to harvest remaining old growth stands as they are more remote and inaccessible.

Present young growth stands do not produce lumber of as high quality as is obtainable from old growth timber and the resulting lumber does not return revenue comparable to income from the sale of better quality lumber. This change in the quality and ease of harvest of the timber resource

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[36]Zaremba, op. cit., pp. 80-81.

has been very gradual and it is difficult for mills to adjust to the change.

Imports are not a serious threat to the lumber industry. In 1962, 89 per cent of the lumber consumed was produced in the United States and 11 per cent came from imports. Since the end of World War II imports have increased rather rapidly; however, the Forest Service projections are that the same proportion of imports to domestic production will hold at the 1962 level through the year 2000.

The picture is not all bleak however. In the very thorough work published by the Forest Service, it is projected that the consumption of lumber through the year 2000 will increase.[37] These projections call for an increase in the total consumption of lumber from the current level of 37.3 billion board feet to 53.5 billion board feet in 2000. Softwoods in 1962 accounted for about 83 per cent of total lumber produced, the ratio that has prevailed over the past forty years. The Forest Service projections are that there will be little change in this proportion.

This upward trend in consumption projected by the Forest Service

> assumes in affect that the substitution of other materials for lumber in housing, shipping and other

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[37] Timber Trends, ibid.

> uses, will proceed at a slower pace in the future than in the past and that such displacement of lumber will be more than offset by growth factors associated with projected major expansion in the nation's economy.[38]

The adjustment to these changing conditions by lumber producers in Arizona is discussed in the following chapters.

The Industry in Arizona

The lumber industry was well established in Arizona long before the Territory was admitted to the Union as the 48th state in 1912. The date of the establishment of the first sawmill in Arizona is not definitely known, but it is believed to have been near Prescott in 1864.[39] Flagstaff, formerly the principal lumber producing town in the state, had a mill in operation as early as 1882.[40] Other mills were established in the Flagstaff area and in the White Mountains of Eastern Arizona in the 1880's and 1890's.[41] Mills were also in operation on the Navajo Indian Reservation[42] and in the forested areas of southeastern Arizona

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[38] Ibid., pp. 41-43.

[39] John S. Spencer, Jr., Arizona's Forests, U. S. Forest Service Resource Bulletin INT-6 (Ogden, Utah: Air Force Printing Plant, 1966), p. 26.

[40] Pauline Henson, "Southwest Forest Industries," Arizona Highways, XL No. 7 (July, 1964), 37.

[41] Stanley Fawcett, "Kaibab: The Vertical Integration of a Family Lumber Company" (unpublished Master's Thesis, Northern Arizona University, 1966), p. 4.

[42] Navajo Forest Products Industries (Navajo, New Mexico: Lytle Corporation, n.d.).

before 1900.[43] By 1889, 13 sawmills were producing about 36,000,000 board feet of lumber a year.

The number of active sawmills reached a peak in 1946 when 66 mills produced 240.7 million board feet of lumber. There has been a sharp reduction in the number of mills since then with only 25 mills reported in operation in 1965 as shown in Table 10.

The number of active sawmills in operation at any given time is difficult to determine due to the volatility of the industry. Published estimates of the number of active mills in Arizona in recent years range from 25 to 38, with different sources reporting different numbers for the same period of time. There are various reasons for mills to cease operations, as is true in other industries, but a wide fluctuation in the number of active mills in the lumber industry is typical.[44]

Fire is a major hazard to sawmills and some of the mills in Arizona had been closed at times due to fires during the period covered by this study. However, there is every reason to believe that the number of active mills in Arizona has declined during the last decade.

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[43]Spencer, op. cit., p. 25.

[44]Nelson, op. cit., p. 34. This study indicates that the number of active mills varied between 200 and 400 in the Ninth Federal Reserve District in recent years with "sharp fluctuations (up to 150 mills) from year to year."

TABLE 10. Number of active sawmills and percentages of total production, by sawmill size classes, 1960, 1962, and 1965.

Sawmill Size Class (thousand board feet per year)	1960[a]		1962[b]		1965[c]	
	No. of Mills	% of Total Production	No. of Mills	% of Total Production	No. of Mills	% of Total Production
Less than 50	1	(d)	0	-	1	(e)
50 to 199	7	0.3	5	0.4	4	
200 to 499	1	0.1	3	0.2	2	
500 to 999	2	0.4	0	-	1	
1,000 to 4,999	15	12.6	7	5.3	3	
5,000 and over	12	86.6	13	94.1	14	
Total	38	100.0	28	100.0	25	

[a]Robert L. Miller, Lumber Production in Arizona and New Mexico, 1960, U. S. Forest Service Research Note RM-19 (Fort Collins, Colorado: Rocky Mountain Forest and Range Experiment Station, 1964), p. 5.

[b]Alvin K. Wilson, Timber Products Output in Arizona and New Mexico, 1962, U. S. Forest Service Research Paper INT-15 (Ogden, Utah: Intermountain Forest and Range Experiment Station, 1964), p. 7.

[c]Forest Products Directory Southwestern Region (Albuquerque, New Mexico: U. S. Forest Service, August, 1965).

[d]Less than 0.05%. [e]Production data by mill size not available for 1965.

Structure of the industry.--The degree of concentration in the ownership of the sawmills in Arizona is small. As there were several changes in the ownership of the various production facilities during the period of the study (1959 through 1965), data indicating concentration is presented only for 1965. In that year the 25 active mills in the state were owned by 20 different firms.[45] As shown in Table 11, the two largest firms each operated 3 mills and another firm operated 2 mills. The remaining 17 companies each operated only one mill in the state.

Several of the firms operated mills in other states in addition to their Arizona operations. However, the companies were primarily Arizona businesses; only two of the firms were headquartered outside the state. One of the companies, Southwest Forest Industries, Inc., is a publicly held company; the other 19 firms are all privately owned.

Although ownership of the mills was not concentrated, there was concentration in the ownership of the plants capable of large scale production. The production of the mills owned by the two largest firms accounted for about two-thirds of total production in 1965. The 9 large (Class 5) mills, which accounted for about 85 per cent of the total production, were owned by only 6 firms.

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[45] One of the sawmills is operated by the United States Department of Justice rather than by a private enterprise. For the sake of simplicity, all the operators will be referred to as "firms."

TABLE 11. Active sawmills in Arizona by firm, location, size, additional equipment, and membership in Western Wood Products Association, 1965.

Firm Name & Home Office Location	Mill Location	Size[a] Class	Additional Plant Equipment[b]		
			Planer	Kiln	Debarker & Chipper
WWPA Members					
Duke City Lumber Albuquerque, N.M.	Winslow	5	x	x	x
Ft. Apache Timber Whiteriver	Whiteriver	5	x	x	x
Haining Lumber Co. Williams	Williams	5	x	x	
Kaibab Lumber Co. Flagstaff	Flagstaff	5	x	x	x
	Fredonia	5	x	x	
	Payson	4	x		
Reidhead & Charlson Lumber	Show Low	4			x
E. O. Reidhead Show Low	Show Low	4	x	x	x
Southwest Forest Industries Phoenix	Eagar	5	x		x
	Flagstaff	5	x	x	x
	McNary	5	x	x	x
Western Pine Sales Globe	Cutter	4	x		x
	Heber	5			x
Non-members, WWPA					
Carrizo Lumber Show Low	Carrizo	4	x		x

TABLE 11.--Continued

Firm Name & Home Office Location	Mill Location	Size[a] Class	Additional Plant Equipment[b]		
			Planer	Kiln	Debarker & Chipper
Horace Crandall Clay Springs	Clay Springs	1A			
J.D. & R.L. Fish Flagstaff	Near Flagstaff	2	x		
Lewis Garvin Clay Springs	Clay Springs	1B			
H. B. Hawkins Grants, N.M.	Near Nutrioso	1B			
Merrill Jessop Colorado City	Colorado City	1A			
Art Leeds Greer	Greer	0			
H. B. Merritt Chino Valley	Chino Valley	3	x		
Mt. Lemmon Lbr	Summerhaven	1A			
A. Louis Peterson Prescott	Prescott	3			
Reidhead Lbr Mill	Nutrioso	3			
U.S. Dept. of Justice Federal Youth Camp Tucson	Mt. Lemmon	1A			

Sources: Forest Products Directory Southwestern

TABLE 11.--Continued

Region (Albuquerque, New Mexico: U. S. Forest Service, August, 1965), and Buyers Manual (Portland, Oregon: Western Wood Products Association, n.d.).

[a]Size Classes	Estimated Annual Production (thousand board feet)
0	Under 50
1A	50-199
1B	200-499
2	500-999
3	1,000-4,999
4	5,000-9,999
5	10,000-and over

[b]An x in a column shows that the mill possesses the equipment indicated.

As has been true throughout the Rocky Mountain area the average size of lumber mills in Arizona has increased significantly.[46] Since 1946, the number of active mills in the state declined from 66 to 25 in 1965 while annual production increased from 241 million board feet in 1946 to 365 million board feet in 1965. Mean production per mill increased from 3.65 million board feet to 8.7 million board feet in 1960 and to 14.6 million board feet in 1965.

Table 11 indicates that in 1965, 8 of the firms had membership in the principal trade association for sawmills in the West, the Western Wood Products Association. All of the firms operating Class 5 and all but one of the firms operating Class 4 mills were members of the Association;

[46]Spencer, op. cit., p. 27.

none of the 11 firms producing under 5 million board feet of lumber annually (Class 3 and smaller) was a member.

In addition to the basic machinery used to convert logs into lumber, mills may have additional equipment to further process the green, unsurfaced lumber into a more useable, saleable product. As discussed above, the operation of a planer to surface the rough lumber is generally considered an integral part of the sawmill operation. Table 11 shows that 10 of the firms operated planers (although not at all of their mills) and the other 10 companies did not have planers at their mills. The 10 firms without planers were, with one exception, all Class 3 and smaller mills.

Most lumber (except Douglas-fir) is dried to a specified moisture content before it can be satisfactorily utilized. Drying can be accomplished in kilns or by yard (air) drying when and where weather conditions permit. As shown in Table 11, only 6 of the firms operated kilns in 1965. Three of the firms operating larger mills (Classes 4 and 5) had no kiln facilities.

In order to convert mill residue and very low quality lumber into chips for sale to pulp mills, 8 of the firms had installed debarkers and chippers at their mills. There were 11 mills with debarkers and chippers in operation in 1965 as indicated in Table 11. This additional equipment has no part in the lumber production process per

se; it does have relationship to the quantity and quality of lumber produced as mills with this machinery convert their low grade lumber into chips rather than attempting to market it as lumber.

There are no published data indicating to what extent Arizona lumber firms are horizontally diversified or vertically integrated. From general knowledge and observation of the industry, it is apparent that only one company has diversified to a significant degree. Southwest Forest Industries, Inc., the largest and only publicly-owned lumber firm in the state, has diversified its manufacturing operations into related forest products areas in recent years.[47] In 1962, the company began operation at Snowflake of the first major pulp and paper producing plant in the state. This plant produces 65,000 tons of Kraft linerboard and 75,000 tons of newsprint annually.

During the last decade, Southwest established or acquired several additional facilities for the conversion of lumber and paper products into boxes, containers, and other related secondary products. In its annual report for 1966, the company indicates that its paper products division now accounts for more sales revenue than does its

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[47]All references concerning Southwest Forest Industries, Inc., are taken from the company's annual statements for the years 1959 through 1966. This firm is one of the 10 largest lumber producers in the United States; it ranks fifth in the production of pine lumber.

wood products division. The firm has announced that it is experimenting with production of plywood from ponderosa pine and there are indications that it plans to establish a plywood plant in Arizona in the near future.

Vertical integration is also very limited among other Arizona lumber firms. As mentioned above, ownership of the resource is primarily public. Lumber firms do engage in the harvesting of logs; however, there are many independent logging contractors also engaged in logging operations. A few of the firms maintain retail lumber yards but these are small scale operations and are primarily located near the mill site. Mill-owned distributing yards acting in the wholesale capacity account for only a minute fraction of the lumber marketed.

The forest resource.--Arizona contains the most extensive continuous area of ponderosa pine forest in the nation.[48] This forest stretches across Arizona in a wide band from the Utah border north of the Grand Canyon National Park, through the San Francisco mountain area of north-central Arizona, and along the Mogollon Rim (Zane Grey's "Tonto Rim") southeasterly to the White Mountains on the New Mexico border. There are smaller stands of timber located in the northeastern and southeastern areas

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[48]All land area and timber volume data in this section are from the most recent and authoritative publication on Arizona's forests: Spencer, op. cit.

Figure 1. Commercial forest area in Arizona, by zone.[a] (Source: Charles C. Minor and Errett M. Conway, An Anlysis of Forest Products Potential in Arizona. Phoenix: Arizona Development Board, no date.)

Zone A - maximum accessibility
Zone B - moderate accessibility
Zone C - minimum accessibility

of the state that are not contiguous with this major expanse of forest.

The total forested area of the state contains 20.6 million acres, 28 per cent of Arizona's land area. Of this forested area, 3,977,000 acres are classified as commercial forest land, i. e., land capable of producing crops of industrial wood. The principal species on 3,657,600 acres (92 per cent) of the commercial forest land is ponderosa pine. The remaining acreage is about evenly divided between Douglas-fir and white fir-spruce stands. Aspen occurs on about 2 per cent of the commercial forest area in the state. To the present time, its use has been very limited; it could, however, be an important source of fiber.

Almost all the commercial forest acreage and timber volume in Arizona are in some form of public ownership. Table 12 indicates that 96 per cent of the commercial forest land and 98 per cent of the timber volume are owned by various public agencies, primarily national forests and Indian tribes. Only one state, Alaska, has a higher percentage of its commercial forest land in public ownership; the average for the Rocky Mountain states is 77 per cent.

Economic importance.--The 1963 Census of Manufacturers provides the most recent authoritative information about the lumber industry in the state. Table 13 indicates that in 1963, the industrial classification of "Lumber and

TABLE 12. Ownership of commercial forest land and of timber volume in Arizona, 1965.

Type of Owner	Land Area		Timber Volume	
	Thousand Acres	Per cent	Million Bd Ft	Per cent
National forest	2,630	66.1	19,153	71.1
Indian tribe	1,144	28.8	7,218	26.8
Bureau of Land Mgmt	2	0.1	1	(b)
State	32	0.8	74	0.3
County & municipal	2	0.1	4	(b)
Farmer	82	2.1	299	1.1
Miscellaneous private	85	2.1	202	0.7
Totals	3,977	100.1[a]	26,951	100.0

[a]Doesn't total to 100.0 per cent due to rounding.

[b]Less than 0.05 per cent.

Source: John S. Spencer, Jr., Arizona's Forests, U. S. Forest Service Resource Bulletin INT-6 (Ogden, Utah: Air Force Printing Plant, 1966), p. 4.

Wood Products" (Code 24) contributed $25,000,000.00 in value added by manufacturing to the state's economy. While this does not seem to be a large sum, it is significant in a state where the manufacturing sector is not the predominant contributor to the economy of the state. A comparison with the largest manufacturing industry's value added contribution of $86,000,000.00 adds importance to the amount of $25,000,000.00 for lumber and wood products.

Another indicator of the importance of the industry to the state is the number of people employed in the

TABLE 13. Value added by manufacturing, Arizona, 1958 and 1963.

Industry Classification	1958 Value Added in Millions of Dollars	1958 Rank	1963 Value Added in Millions of Dollars	1963 Rank
Electrical machinery	20	6	86	1
Transportation equip.	62	1	78	2.5
Food & kindred prod.	57	2	78	2.5
Primary metal industries	41	3	74	4
Machinery, except electrical	19	7	51	5
Printing & publishing	26	4	45	6
Stone, clay & glass products	25	5	44	7
LUMBER & WOOD PRODUCTS	15	8	25	8
Fabricated metal products	13	9	24	9
Chemicals & allied products	9	10	16	10
Apparel & related products	7	11	13	11
Furniture & fixtures	4	12	7	12
Misc. manufacturing	3	13	4	13

Source: U. S. Bureau of the Census, Census of Manufacturers, 1963, Bulletin MC63(3)-3, (Washington: U. S. Government Printing Office, 1966), p. 3.

industry. Employment in the lumber and wood products manufacturing classification for 1963 was 3,022 out of a total manufacturing employment in the state of 57,039.[49] In March, 1965, employment in the industry in Arizona was

[49]U. S. Bureau of Census, Census of Manufacturers, 1963, Bulletin MC 63(3)-3 (Washington: U. S. Government Printing Office, 1966), pp. 3-4.

3,282, ranking the industry sixth in the state in manufacturing employment.[50]

No data are available to indicate the average of lumber shipments. The 1963 Census of Manufacturers reports that the value of shipments for the classification of "Sawmills and Planing Mills" (Code 2421) was $35,002,000.00. Based on a reported production of 357,000,000 board feet of lumber in 1963, this would indicate that the mean price of lumber sold per thousand board feet (the standard unit of measurement in the industry) was about $98.00. This figure appears high in view of market prices for lumber at that time (pricing is discussed in Chapter V).

It is interesting to note in Table 13 that lumber and wood products maintained its eighth place rank in both 1958 and 1963 while "Electrical Machinery" jumped from sixth place in 1958 to first place in 1963. The magnitude of other changes was not so pronounced although there were minor shifts in the classification of "Machinery, Except Electrical," "Printing and Publishing," and "Stone, Clay and Glass Products," The next Census of Manufacturers will reflect the impact of the new pulp and paper plants in the state; it will be interesting to see if the lumber and wood products class maintains its relative position.

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[50]Ralph C. Hook, Jr. and Jack Kekar, Industrial Development in Arizona: Manufacturing 1965 (Phoenix, Arizona: Development Board, 1965), p. 10.

Problems peculiar to the industry in Arizona.--It has been indicated above that the lumber industry in the United States has not shared in the expansion of the nation's economy and that its future growth is dependent upon the discovery of solutions to several critical problems. In addition to the problems faced by the industry in general, there are several problems unique to the industry in Arizona.

One of the most serious problems for the industry in Arizona is the low quality of the raw material upon which the industry is totally dependent. The Pacific Northwest Forest and Range Experiment Station has developed a six-grade ponderosa pine grading system for evaluating the quality of ponderosa pine saw logs. Grade 1 indicates the highest quality log and grade 6 the lowest quality. Based on this grading system, over 80 per cent of the saw logs in recent timber sales in Arizona have been of grades 4 and lower, and most of the logs in this classification were in the grades of 5 and 6.[51] Barger and Fleischer stress the impact of this low quality timber upon the Arizona industry:

> The utilization of this low-quality timber creates technological and economic problems for a regional

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[51]Roland L. Barger and Herbert O. Fleischer, New Products from Low-Grade Ponderosa Pine, U. S. Forest Service Research paper RM-10 (Fort Collins, Colorado: Rocky Mountain Forest and Range Experiment Station, December, 1964), p. 3.

> industry historically geared to single-product lumber operations. Much of the saw-log material currently available is unsuited to profitable production of lumber. Lumber grade recovery from ponderosa pine in this region commonly includes as much as 40 percent 4 and 5 common lumber. These grades have never been more than marginal products, a situation aggravated by a depressed and declining lumber market. Since these grades of lumber make up an important part of total out put, the economic impact upon the industry is severe.[52]

The quality of sawtimber is expected to continue to decline as remaining old-growth stands are harvested.[53]

Another problem of paramount importance is emphasized by Spencer:

> . . . the major wood product manufactured in Arizona, in terms of volume of wood, is still 1-inch-thick lumber. This provides cause for concern in view of the increasing encroachment by plywood and other sheet product manufacturers into the market for sheathing and sub-flooring materials--a high volume market formerly dominated by the lumber industry. This concern is accentuated because no plywood or veneer is presently produced in Arizona.[54]

This is not a problem unique to Arizona but it is emphasized here due to the lack of other methods in the state of processing and utilizing the forest resource.

These two problems, the low quality of the raw material and the reliance upon the production of a product that is being replaced in many markets, pose serious problems for the future of the industry in Arizona. These

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[52]Barger, op. cit., p. 2.

[53]Spencer, op. cit. p. 34.

[54]Ibid., p. 30.

two problems are compounded by the fact that almost all of the raw material is publicly owned. Public ownership of the sawtimber limits entrepreneural activity and initiative and provides restraints upon management that firms owning their own timber do not have. Government ownership also gives added importance to the ways the resource is used as it is in the nation's interest to insure that the optimum utilization is being made of the total forest resource.

Solutions to these problems must be found if the industry in Arizona is to survive as a healthy, important contributor to the state's economy.

CHAPTER III

RESEARCH METHODOLOGY

The purpose of this chapter is to present in detail the methods used to obtain the data reported in Chapters IV and V. A sampling procedure was used and it is important for the proper interpretation of the survey data to understand the methods used in collecting it.

Mills included in the study

The first problem was to decide whether to attempt to include all of the active mills in the state in the study or to select a representative sample of the mills. Preliminary discussions with management personnel at a few of the mills indicated that good co-operation would be secured from the mills. Although the researcher believed that all mills would co-operate, it was undetermined whether or not complete access to invoice files would be granted by all firms.

As indicated in Table 14, there were 25 active mills in the state in 1965, ranging in annual production capacity from very small to very large. The smallest mill produced less than 50,000 board feet per year and the largest mill produced some 85,000,000 board feet per year.

For this study the mills were arbitrarily divided into small, medium, and large classes as shown in Table 14.[1]

TABLE 14. Number of active mills and number of mills included in sample, by size class, 1965.

Class Size	Estimated Annual Production (thousand bd ft)	Number of Active Mills (1965)	Number Included in Sample
Small - 0	Under 50	1	0
1A	50-199	4	0
1B	200-499	2	0
2	500-999	1	0
Medium - 3	1,000-4,999	3	1
4	5,000-9,999	5	3
Large - 5	10,000 and over	9	8
Total		25	12

Source: Forest Products Directory Southwestern Region (Albuquerque, New Mexico: U. S. Forest Service, August, 1965).

As the universe under study was composed of only 25 mills, neither a simple random sample nor a stratified

[1]It is interesting to compare these size classes with the Northeast study (Wallace W. Christensen et. al., Marketing of Lumber Produced by Sawmills in the Northeast--Phase I, West Virginia University Bulletin 478 /Morgantown, West Virginia: Agricultural Experiment Stations, 1962/.) In that study the size classes were: Small mills--under 500,000 BF annual sales; medium mills--500,000 to 3,000,000 BF annual sales; large mills--over 3,000,000 BF annual sales (p. 6). From this it is assumed that, in general, the Arizona mills are larger than the typical Northeastern mills.

random sample was a practical approach to the problem. It was essential that all of the large and most of the medium sized mills be included in the sample to insure that an accurate view of Arizona lumber marketing would be obtained. The exclusion of 2 or 3 of the large mills would seriously distort the data and simple or stratified random sampling could possibly eliminate several of the larger mills from the sample. It was also not known whether permission to examine invoice files would be given by all mills and the refusal by one or two mills selected in a random sample would negate the value of random sampling.

It was decided to include all large mills and several medium sized mills in the sample, insuring that at least 90 per cent of production capacity would be included in the sample. Small mills were excluded as it was thought that data from them would not add to or alter the information obtained from the medium and large mills. Using the upper limit of the class intervals for the small mill classification, the 8 small mills could not produce over 3,000,000 board feet per year, less than 1 per cent of total annual production capacity in the state.

The time factor was another reason for excluding the small mills. To secure co-operation from the mills, to locate their files, and to record the data was time consuming; the return from the time invested in collecting data from the small mills would not warrant their inclusion

in the sample. As the field work progressed, it proved to be a wise decision as sales invoices were not always available and data collection proved to be a slow and tedious process.

Co-operation was secured from 8 of the 9 large mills. A convenience sample of 4 of the medium sized mills was selected and all 4 of these made their files available. These 12 mills, owned by 7 different firms, accounted for 93 per cent of the total annual production in 1965.

Time period

The research plan was to collect information for the period 1956-1965 so as to identify markets and trends in these markets. Originally it was thought that data from 1945 to the present should be included, but after preliminary investigation, the researcher realized that sales invoices going back 20 years would not be available and the plan was revised to include only data for the last 10 years. During the field work it soon became apparent that invoices prior to 1959 were not available in sufficient quantity to warrant their collection. The plan was revised to cover the period of 1959 through 1965.

It also developed that there were gaps in the invoice files of the various companies due to changes in ownership, losses from fire and water damage, planned destruction of old files, et cetera. Consequently, the

data are not complete for any mill for the entire 7-year period (Table 15).

TABLE 15. Mills included in sample, by class size and years for which data was collected.

Mill No.	Class Size	1959	1960	1961	1962	1963	1964	1965
1	4	x	x	x		x	x	x
2	4					x	x	x
3	5							x
4	5	x	x	x		x	x	x
5	5	x		x	x	x	x	x
6	5	x	x	x		x	x	x
7	5					x	x	x
8	5	x		x	x	x	x	x
9	3	x	x	x		x	x	x
10	4	x				x	x	x
11	5						x	x
12	5				x	x	x	x
Number of Mills		7	4	6	3	10	11	12

x indicates data collected for that year.

In view of the small number of invoices available for the years 1960 and 1962, it was decided to report the data for the odd-numbered years of 1959 through 1965, although data had been collected for all years. At least 50 per cent of the productive capacity is represented by the firms included in the sample in the odd-numbered years and complete coverage is provided for 6 of the 12 mills.

Data for 1964 could have been included as only 1 mill is not represented in the 1964 data. An examination

of the data obtained revealed that there is no significant change in the 1964 data from the 1963 and 1965 data and for simplicity's sake it was decided to eliminate reporting data for 1964.

It is possible to generalize about all the Arizona lumber marketed for 1965 from the data collected as these data represent 93 per cent of the total production for that year. For the years prior to 1965, the only assumption made is that the data are representative of the mills included in the sample and not the entire industry in Arizona.

Part of the research plan was to collect data over a period of years in order to identify trends in the products marketed and the markets for Arizona lumber. It was not possible in this study to use any of the various trend line equations due to the incompleteness of the data. It would not be proper to use annual data from different mills in order to develop trends; the base should remain unchanged throughout the time period. The inclusion for one or two years of the period of a mill that marketed products significantly different from the other mills would distort the data and present trend data not true for the industry as a whole.

As the same 6 mills were represented in all 4 sample years, it was thought that these could be used to establish trend lines. However, data from 2 of the mills

for 2 different sample years were intermingled with data from other mills under the same ownership so that separate data for the 6 mills for the 4 sample years were not available. Consequently, no trend lines have been established for any of the classifications of data used in the study. Significant changes in any of the classifications that appeared during the sample years are examined in Chapter V.

Selection of sample invoices

The sampling procedure for the selection of invoices to be recorded involved a probability sample of the systematic type consisting of the selection of every twentieth invoice after a random start for the first invoice.[2] This practice was repeated at every company for each year.

The files, with only one very minor exception, were filed in chronological order. It is believed that chronological filing is equivalent to random filing and that systematic sampling does, therefore, provide a good probability sampling. There was no intention to analyze seasonal variation and it does appear that any type of periodicity would occur in such a filing method for sawmills.

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[2]Harper W. Boyd, Jr. and Ralph Westfall, Marketing Research (Homewood, Illinois: R. D. Irwin, 1964), pp. 411-415. Although the writer used many sources for guidance in his sampling procedure, the Boyd and Westfall procedure was the basis for the sampling technique in this study.

Most of the mills operate on a fiscal year basis that does not coincide with the calendar year. As most industry data is reported on a calendar year basis and as the fiscal years of the various firms were different, it was decided to report data in this study on a calendar year basis. Where there was no break in the invoice files, there was no problem involved in collecting the data on a calendar year basis. The date of each invoice included in the sample was recorded and it was a simple procedure to sort the final punch-cards into calendar year groups for computation and analysis.

Where a break in the files occurred, a more involved sampling procedure was used. If the invoices for an entire fiscal year were not available, only partial data for the preceding and succeeding calendar years would be available. For example, if the files were missing for the fiscal year of March, 1962, through February, 1963, data would be available for the first 2 months of 1962 and the last 10 months of 1963. In one such situation, after assurances from executives of the firm that there was no change in their normal sales pattern, the data for the first 2 months of 1962 was combined with the data from the last 10 months of 1963 to give a complete 12 months of data.

In another situation involving a fiscal year of April through March, the sampling rate was increased to pro-

vide an equivalent number of invoices that would have been expected if the first 3 months of the calendar year had not been missing. This increase was based on a count of the number of invoices in the comparable period for other years and assurances from management that there had been no significant change in the sales for that period.

A third case involved the unavailability of an invoice file for the month of July. Again, the sampling rate was increased for May, June, August, and September to provide an appropriate number of invoices for that year.

In other situations where invoices were not available and the quantity missing was too large to make adequate adjustment, the data were discarded for the entire calendar year. Fortunately, in many cases of missing invoices, the gaps were such that complete calendar year data could be obtained without adjustment. Although much data had to be discarded because of gaps or could not be collected as the entire file for a year was missing, the resulting complete data does give good coverage for the mills indicated in Tables 15 and 16.

Adjustments in the original data to provide calendar year information affected only a very small proportion of the data included in the final sample. No adjustments were made in 1959 or 1965 data and only a minute adjustment was made in 1961 data. Most of the adjustments that were made involved 1963 invoices. A critical compari-

son of the raw data for 1963 with the adjusted data for 1963 did not indicate any significant change in the various classifications.

TABLE 16. Number of mills and number of invoices included in sample.

Type	1959	1961	1963	1965
Number of mills	7	6	10	12
Number of invoices	456	466	728	894
Per cent of total annual production included in sample at 5% sampling rate	52%	54%	70%	93%

The resulting 5 per cent sample of each firm's available invoices proved to represent about 5 per cent of each firm's total board footage marketed where it was possible to compare the sample with corresponding annual sales data. It was not possible to verify the accuracy of the 5 per cent sample for each individual company as annual sales data were not made available in some cases or the data were on a fiscal year basis which did not coincide with the calendar year basis of the sample. However, for the year 1965, 4.67 per cent of the total annual production of all the mills in Arizona was included in the sample data. Inasmuch as the sample mills accounted for approximately 93 per cent of total production, this would indicate that the 5 per cent sampling was quite accurate for that

year.

In the case of one of the large companies, it was possible to compare the sample data for 1965 with the firm's sales volume for calendar year 1965. The sample proved to contain 4.995 per cent of the actual board footage sold by that firm for that year.

All information on the selected invoices was recorded by means of reading the information from the invoices into a tape recorder. The tapes were transcribed onto specially prepared columnar worksheets. These worksheets were then coded so that keypunch operators could record the information on punch cards. One punch card was prepared for each lumber item on an invoice and a summary card was prepared for each invoice. This required the preparation of some 9,000 cards. The information recorded from these invoices included the date of the invoice, the buyer or buyers' names and addresses, the type, quantity, and quality of the lumber sold, the method and cost of delivery, and the dollar value of the invoice.

The research plan included the collection of the value of the shipments and the cost of transportation; however, this information was not reported on all invoices and, hence, it has been excluded from the analysis of the data. With this exception, the remaining information was complete and consistent in all firms and a thorough analysis has been possible due to the consistency of the data.

The collection of the information from the invoices required about 12 weeks of full-time field work. The coding and keypunching were completed in about 2-1/2 months. The data on the punch cards were then compiled into 19 different classifications by the use of an IBM 1620 computer.

In order to determine channels of distribution, it was necessary to identify as to type each buyer listed on an invoice. It was, of course, impossible to determine from the invoice the type of firm purchasing the lumber. Fortunately, an accurate method of identifying the firms was made available to the researcher. The Lumbermen's Credit Association publishes an annual Reference Red Book in which all firms in the forest products industry are listed.[3] The Red Book is used primarily for credit purposes but it also contains information as to the type of business engaged in by each firm and the location of branches, plants, and purchasing offices for each company in the industry. No other one source could possibly have provided this information.

A list of 41 possible classifications of buyers was prepared and buyers listed on the sample invoices were identified as to type by reference to the Red Book. Two editions of the Red Book were made available to the

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[3]The Lumbermen's National Red Book Service Reference Book (Chicago: Lumbermen's Credit Assoc., Inc.)

researcher by the Association, the 1963 and 1966 editions. Other editions were not available to the researcher.

As the wood products industry is a dynamic one, there were many changes in the firms during the 7-year period. Some firms could not be identified from reference to the Red Book due to changes in ownership or firm name, consolidations, and discontinuances. However, the percentage of such firms was small. Of the 1,800 firms listed on the sample invoices, over 1,700 were identified as to type of business.

In a few instances (less than 0.5 per cent) firms not listed in the Red Book were identified as to type by reference to the company name. If the name carried some specific designation, such as the ABC Planing Mill, the company was identified as to type by the name. In cases where the buyers were known to be engaged in some business not connected with the forest products industry, the classification of "other business firms" was used.

Inasmuch as the number of mills included in the sample varies from year to year, no attempt has been made to determine the extent of the sampling error. Under these circumstances it was not possible to apply probabilistic statistical inference techniques to the data. However, an analysis of the data for each of the 7 years indicates that, in most of the classifications, there are only small fluctuations in the data from year to year. These fluctua-

tions could be the result of sampling error or actual fluctuations in the original data. However, due to the consistency of the data, it is believed that the sampling error is very small. In most cases, significant changes in the data from year to year can be explained by external forces and are not attributed to sampling error. The discussion of these changes is contained in Chapter V.

Sample characteristics

As shown in Table 16, there were 2,544 sales invoices included in the sample for the 4 odd-numbered years of 1959 through 1965. At a 5 per cent sampling rate, the sample represented a low of 52 per cent in total production in 1959 and a high of 93 per cent in 1965. Table 17 indicates that there was a year to year variation in the average amount of lumber per invoice for the sample period with a mean of 17,091 board feet in 1963 and a mean of 19,749 board feet in 1959. The distributions of invoice sizes are not normal distributions as can be seen in the frequency distributions in Table 17.

The lack of normal distributions of invoice sizes is of no concern, however, as invoice statistics as such are of little importance to this study. If each invoice carried only one item of lumber, invoice statistics would be the basis of the analysis of what lumber products had been marketed. As indicated in Table 18, there were many

multiple-item invoices with the mean number of items per invoice ranging from a low of 1.32 in 1965 to a high of 1.65 in 1961.

TABLE 17. Percentage distribution of invoice sizes, 1959-1965.

Invoice Size (board feet)	1959	1961	1963	1965
Under 10,000	14.7	23.2	31.6	25.1
10,000 - 19,999	29.6	29.4	28.3	29.1
20,000 - 29,999	46.5	34.4	26.5	27.6
30,000 - 39,999	8.3	12.0	12.4	15.3
40,000 and over	0.9	1.0	1.2	2.9
Total	100.0	100.0	100.0	100.0
Mean	19,749	18,832	17,091	19,089

See Table 1, Appendix D.

In order to ascertain what products had been marketed, it was necessary to break down the data on an item basis rather than on an invoice basis. The 2,544 invoices used in the sample contained 3,675 individual items. As board footage data would be difficult to interpret, all data are reported on a percentage basis. The base for each percentage figure is indicated in each of the tables. In general, an item is reported as a percentage of the total lumber in the classification to which it belongs and as a percentage of all lumber marketed.

TABLE 18. Number of items per invoice, 1959-1965.

Sample	1959	1961	1963	1965
Number of invoices	456	466	728	894
Number of items	648	765	1,077	1,185
Mean items per invoice	1.42	1.65	1.48	1.32
Per cent of one-item invoices	73.5	63.1	70.0	78.2
Per cent of multiple-item invoices	26.5	36.9	30.0	21.8

A warning is in order here. The percentages have been carried out to one decimal point so that small quantities of a given classification would be reported and not ignored. Carrying percentages to the first decimal should not be interpreted as indicating significant differences. The percentages should be used only as general, not specific, indicators of the proportions of the various classifications. As mentioned above, sampling error has not been determined and small changes in the data certainly could be the result of sampling.

When possible, sample data from a mill for given classifications were compared with annual data for the mill. In no case where comparison of major classifications was possible were the sample data off more than 2 or 3 percentage points from the total data. This applied only

to major classifications that, in general, accounted for at least 15 to 20 per cent of the total lumber marketed by a mill. Interviews conducted with mill management personnel after the data had been processed confirmed the writer's opinion that the sampling provided an accurate report of lumber sales for the sample period.

Interviewing procedure

Interviews were conducted with management personnel from each of the 7 firms included in the sample. In addition, research analysts of the Rocky Mountain Forest and Range Experiment Station of the U. S. Forest Service, faculty members of the School of Forestry at Northern Arizona University, management personnel at two other lumber firms not included in the study, a representative of the Western Wood Products Association, and the manager of a wholesale lumber firm were interviewed during the preparatory and investigative phases of the study. A total of 27 persons was interviewed personally by the writer, many of them being interviewed more than once.

Although the interviews were non-structured, a general outline of questions to be asked was followed in the interviews with mill management. A tape recorder was used to record two lengthy interviews with sales managers. These tapes were transcribed for analysis and reference purposes.

The basic purpose of the interviews with mill management was to determine marketing procedures used by the firms. Other interviews were conducted to supplement the information gained from management personnel and to provide background information for a better understanding of the Arizona lumber industry. The information obtained from mill management is reported in Chapter V in the section concerning the performance of marketing management functions by the various firms in Arizona.

CHAPTER IV

PRODUCT AND MARKET CHARACTERISTICS

Various types and kinds of lumber products are produced and marketed by lumber producers. This chapter reports the kinds of lumber products that were marketed by Arizona producers during the 7-year period covered by this study. It also reports where the markets for Arizona lumber were located, the types of middlemen that purchased it, and the transportation media used to transport it to the final buyers.

To avoid excessive detail in the report, many of the tables in the chapter have been constructed so as to report only significant classifications of lumber; tables reporting all of the various classifications in detail are placed in Appendix D. For easy reference, each summary table in the chapter carries a reference to the appropriate complete table in Appendix D.

Grades and Size Classifications

Lumber grades are complex and difficult to understand by persons not intimately involved in the industry. Complete information on grades is contained in the Western

Wood Products Association's Standard Grading Rules[1] and no attempt will be made here to explain the various grades in detail. However, a brief explanation of the grades and size classifications used in this study is in order.

In general, there are 2 ways to classify lumber: on the basis of the quality of the wood or on the basis of the dimensions of the lumber. Each of these classifications and how they are used in this report will be discussed.

There are 3 general quality classifications: selects, factory and shop, and commons. The term selects designates lumber that is free or nearly free of defects (such as knots and blemishes). Lumber of this classification is used for finish work where appearance is of paramount importance. There are 3 grades of selects: 1 and 2 Clear (B and Better), C Select, and D Select, in descending order of quality. For this study, no differentiation is made between the various select grades. Moulding grade is reported with the selects as it is very similar in characteristics and end use. Many invoices grouped D Select and Better with Moulding and it was impossible to differentiate between the 2 grades.

Factory and shop lumber (hereafter referred to only as shop) is lumber that is intended for secondary manufac-

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[1] 1965 Standard Grading Rules (Portland, Oregon: Western Wood Products Association, 1965).

turing into window sash, doors, and various other kinds of millwork. There are 4 shop grades: Factory Select, No. 1 Shop, No. 2 Shop, and No. 3 Shop, again in descending order. As this lumber is to be used in the manufacturing of window sash and doors, the grades are determined by the extent of the area of each piece that is suitable for such use.

In addition to these 4 grades, mills in Arizona use another grade termed Shop Outs. This grades is applied to lumber originally graded as one of the shop grades but at the time of sale is not of sufficient quality to be graded as No. 3 Shop. For this study, the classifications of Shop and Shop Outs have been used to report all grades of shop lumber.

Grades of commons are divided into 2 general groups depending upon the intended use of the lumber. Thinner lumber (less than 2 inches in thickness) is graded on an appearance basis while thicker lumber (2 inches and thicker) that is intended for framing and related uses, is graded on a structural basis.

The thinner lumber (generally referred to as boards) are reported here in 2 classifications: No. 2 Common and Better (which includes No. 1 Common) and No. 3 Common and Poorer (which includes No. 4 Common and No. 5 Common). Lumber 2 inches and thicker (commonly called dimension lumber) is reported in 3 grades: Standard and Better (which includes Select Merchantable and Construc-

tion), Utility, and Economy

The second major method of classifying lumber is by the thickness of the piece of wood. The 2 common classifications are 1 inch lumber (boards) and 2 and 3 inch lumber (dimension). Dimension can be up to 5 inches thick but very little Arizona lumber was marketed in thicknesses greater than 2 inches; the class of 3 inches and thicker reports all other dimension lumber.

In addition to the 1 inch and 2 inch classifications, fractional sizes (in quarters of an inch) are used for some lumber. Lumber sold in these thicknesses is referred to as 5/4 lumber, 6/4 lumber, et cetera. For example, 6/4 lumber would have a nominal thickness of 1-1/2 inches. In general, most of the fractional lumber is shop lumber; however, in Arizona a large quantity of 6/4 commons was sold.

The actual measurement of lumber thicknesses and widths is as complex to the uninitiated as the grading procedure. In general, the measurements are based upon the measurement of the piece of wood as it leaves the edgers and trimmers in the sawmill while it is still in an unsurfaced and green condition. The finished dimensions of dry, surfaced lumber are not the same as the nominal dimensions generally used to indicate a specific type of lumber. For example, a piece of dry, surfaced lumber sold as a 1 by 8 inch board would actually be 25/32 inches by 7-1/2

inches and in some cases it is sold in thicknesses of 11/16 and 47/64 inches. Dimension sold as 2 by 4, for example, would actually be 1-5/8 by 3-5/8 inches. In case of 6/4 lumber sold as 2 by 4, the thickness would be either 1-9/16 or 1-1/2 inches depending upon the original thickness of the 6/4. A detailed table showing nominal and dressed thickness and width measurements is presented in Appendix E.

General characteristics of lumber marketed

It was originally planned to limit this study to the marketing of lumber made from ponderosa pine as it is the predominant species in the state. However, all of the mills produce some lumber from Douglas-fir and white fir and the proportion of these species can be rather significant for some mills due to their location (see Appendix F for a description of these species). The mix of ponderosa pine, Douglas-fir, and white fir varies depending upon the areas being logged. As mills must market the lumber produced from all species, it was decided to report data on the basis of all lumber marketed regardless of species. Significant differences in the data due to the type of species are discussed in Chapter VI.

Table 19 indicates the percentage of lumber from each type of species that was marketed in the sample years. Ponderosa pine is the principal species, accounting for

about 85 per cent of all of the lumber marketed. Douglas-fir and white fir each accounted for about 7 per cent and there were small quantities of spruce in some years. The "mixed species" classification represents spruce and white fir that was not segregated into separate species classifications.

TABLE 19. Species of lumber marketed by Arizona producers, 1959-1965.

Species	Per cent of Total			
	1959	1961	1963	1965
Ponderosa pine	89.1	82.3	84.0	87.6
Douglas-fir	5.3	7.5	7.2	7.2
White fir	3.9	9.6	8.7	5.1
Spruce	0.3	0.3	-	-
Mixed species	1.4	0.3	0.1	0.1
Total	100.0	100.0	100.0	100.0

The quality of the lumber produced from Arizona timber is low. Table 20 indicates that only 35 to 45 per cent of the lumber was in the better grades. The division between the better grades and the poorer grades for this table is the same division used in the Northeast study so that comparison could be made with lumber quality in that section of the country.[2] A more meaningful distribution

[2]Wallace W. Christensen, et al., Marketing of Lumber Produced by Sawmills in the Northeast--Phase I, West

of grades is shown in Table 21. Commons accounted for 70 to 77 per cent of all the lumber marketed during the survey

TABLE 20. General quality classifications of lumber marketed by Arizona producers, 1959-1965.

Quality Classifications	Per cent of all lumber			
	1959	1961	1963	1965
Better grades (No. 2 Common & all better grades)	40.4	34.1	35.9	45.8
Poorer grades (No. 3 Common & all poorer grades)	59.6	65.9	64.1	54.2

See Table 2, Appendix D.

TABLE 21. Percentage distribution of types of lumber, by general quality classifications, marketed by Arizona producers, 1959-1965.

Grades	1959	1961	1963	1965
Selects	6.4	5.4	6.7	7.0
Shop	22.7	17.3	15.6	20.8
Commons:				
Boards (less than 2" thick)	57.1	57.0	50.8	44.1
Dimension (2" & thicker)	13.8	20.3	26.6	27.9
Other	-	-	0.3	0.2
Total	100.0	100.0	100.0	100.0

See Table 2, Appendix D.

Virginia University Bulletin 478 (Morgantown, W. Virginia: Agricultural Experiment Station, 1962), p. 5.

period. With the exception of 1965, over 1/2 of the lumber marketed was in the board classification (less than 2 inches thick) that is used in construction as sheathing, sub-flooring, and roof decking. Only about 6 to 7 per cent of the lumber marketed was in the select grades.

Table 22 indicates the percentage of each of the various size classifications of lumber marketed during the sample period. One inch boards accounted for approxi-

TABLE 22. Percentage distribution of thicknesses of all lumber marketed by Arizona producers, 1959-1965.

Thickness (in inches)	1959	1961	1963	1965
1 (incl. 6/4 RS)	47.1	54.6	52.9	39.9
5/4	9.2	6.7	6.1	10.0
6/4	20.1	14.2	10.4	16.6
2	13.2	19.9	25.6	26.7
Other	10.4	4.6	5.0	6.8
Total	100.0	100.0	100.0	100.0

See Table 3, Appendix D.

mately 1/2 of all the lumber marketed in 1959, 1961, and 1963.[3] In 1965 there was a decrease to only 40 per cent in this classification. Dimension varied during the

[3]All references in the remainder of the report include 6/4 resawn lumber with the 1 inch commons. One inch and 6/4 resawn lumber are approximately the same thickness and have the same end use; the 2 classes are included in the 1 inch category to indicate usage of the lumber.

sample period with the quantity of dimension doubling during the 7 years to about 27 per cent in 1965. Lumber in the 4/4 to 8/4 measurements varied from a low of 10 per cent in 1963 to a high of about 20 per cent in 1959 (Table 12, Appendix D). A factor complicating the presentation of the data was that much of the 4/4 to 8/4 lumber was either in combined thicknesses or no specified thicknesses were listed on the invoice. In other words, the invoice listed a certain quantity of 5/4 and 6/4 No. 3 Common with no distinction being made as to what proportion was 5/4 and 6/4.

Resawn lumber.--Most significant of the variations from the normal size and grading standards outlined above was the large quantity of lumber sold as resawn lumber. This classification designates a piece of lumber that has been cut to a nominal 1 to 2 inch thickness and, after surfacing and drying, is recut into 2 thinner boards. The resulting lumber is generally sold without further surfacing and is, therefore, surfaced on 1 side and rough on the other. Table 23 shows that about 20 per cent of all lumber sold was resawn lumber. Almost all of the resawn lumber was in the 6/4 inch thickness (Table 5, Appendix D).

The resawing of 6/4 stock results in two 3/4 inch boards that are almost equivalent to 1 inch boards in finished thickness and are not differentiated in use from comparable grades of 1 inch boards. Over 92 per cent of

TABLE 23. Percentage of resawn lumber marketed by Arizona producers, 1959-1965.

Type	1959	1961	1963	1965
Resawn	22.6	21.3	19.3	18.2
Not resawn	77.4	78.7	80.7	81.8

the 6/4 resawn was in the common grades of No. 3 Common and Poorer and about 6 per cent in No. 2 Common and Better (Table 6, Appendix D).

Conditioning and surfacing of lumber.--Lumber is usually dried to a specified moisture content (19 per cent in most cases) either in a kiln or by air drying in the yard. Many invoices indicated that the lumber had been kiln dried or that it had been air dried; however, many invoices did not indicate the type of drying, listing only dried lumber. No distinction has been made in this study, therefore, between kiln dried lumber and air dried lumber. About 91 per cent of all lumber marketed by Arizona producers during the sample period was sold as dried lumber as shown in Table 24. The green lumber was primarily Douglas-fir, the only species that can be utilized in construction work without drying. The small quantity of pine lumber sold green was primarily sold to remanufacturers who would kiln dry the lumber before processing it.

Lumber is sold either surfaced (dressed) or rough.

TABLE 24. Moisture condition of lumber marketed by Arizona producers, 1959-1965.

Moisture Condition	Per cent of Total			
	1959	1961	1963	1965
Green	7.4	6.6	10.7	9.9
Dried	92.6	93.4	89.3	90.1

Lumber that has been processed through a planer to surface or dress one or more sides is referred to in this report as surfaced lumber and lumber that has not been planed on any surface is classified as rough lumber. Table 25 indicates that about 93 per cent of all Arizona lumber was marketed as surfaced lumber. This percentage held fairly constant for the sample period.

TABLE 25. Surface condition of lumber marketed by Arizona producers, 1959-1965.

Surface Condition	Per cent of Total			
	1959	1961	1963	1965
Rough	9.7	6.7	6.2	7.1
Surfaced	90.3	93.3	93.8	92.9

Lumber is sometimes worked to a pattern finish to adapt it to specific end uses. Examples of patterns are

shiplap, drop siding, log cabin siding, bevel siding, et cetera. No attempt was made to tabulate separately the various patterns. As shown in Table 26, 5 per cent of all lumber was marketed with a pattern finish; this percentage held constant for all sample years.

TABLE 26. Percentage of Arizona lumber marketed with and without pattern finish, 1959-1965.

	Per cent of Total			
Type	1959	1961	1963	1965
Pattern finish	5.0	5.3	4.9	5.4
No pattern	95.0	94.7	95.1	94.6

Boards.--During the period of the study, 1 inch boards accounted for about 25 to 35 per cent of all of the lumber marketed as indicated in Appendix D, Table 4. As discussed above, 6/4 resawn lumber could properly be considered as boards. When 6/4 resawn is added to the 1 inch boards, this classification accounted for about 50 per cent of all lumber in 1959, 1961, and 1963; it dropped to only 40 per cent in 1965 (Table 22).

Over 85 per cent of the 1 inch boards were No. 3 Common and Poorer and this grade accounted for about 42 to 50 per cent of all lumber except in 1965 when it dropped to 35 per cent as shown in Table 27.

TABLE 27. Per Cent distribution of grades of 1 inch lumber (including 6/4 resawn) marketed by Arizona lumber producers, 1959-1965.

Grade	% of Boards (incl. 6/4 RS)			
	1959	1961	1963	1965
Select	1.8	4.1	5.5	1.6
Shop	4.1	2.1	2.7	2.6
Commons:				
2 and Better	4.8	3.7	4.5	8.1
3 and Poorer	89.3	90.1	86.8	87.6
Mill Run	-	-	0.5	0.1
Total	100.0	100.0	100.0	100.0

See Table 7, Appendix D.

Only small quantities of 1 inch boards were sold in the grade of No. 2 Common and Better although there was a significant increase in this classification in 1965. Shop grades made up the remaining 6 to 8 per cent in 1959, 1961, and 1963. In 1965, these classifications dropped to only about 4 per cent of all boards.

Table 28 indicates that about 70 per cent of all 1 inch boards was sold in widths of 8 inches and wider. Very small quantities of 4 inch or 10 inch boards were sold (Table 9, Appendix D). The 2 inch and 3 inch boards were firring strips. Normally these are ripped from wider boards at the retail yard or at the construction site.

Dimension.--The proportion of lumber sold as

TABLE 28. Percentage distribution of widths of 1 inch lumber marketed by Arizona lumber producers, 1959-1965.

Widths	1959	1961	1963	1965
6" and narrower	18.5	11.4	12.8	14.5
8" and wider	68.5	69.0	70.4	76.0
Random widths	13.0	19.6	16.8	9.5
Total	100.0	100.0	100.0	100.0

See Table 9, Appendix D.

dimension doubled during the sample period. Table 22 shows that 13 per cent of all lumber in 1959 was dimension; this had increased to 27 per cent in 1965. Although the proportion of shop lumber fluctuated erratically, it appears that most of the increase in dimension was related to the decrease in the proportion of boards.

About 1/2 of the dimension was sold in the Standard and Better grade and about 1/3 in Utility grade as shown in Table 29. There was a decline in Utility grade from about 39 per cent in 1959 and 1961 to 31 per cent in 1965. Economy grade increased from about 6 per cent in 1959 to 12 per cent in 1965.

Most of the dimension was marketed as 2 by 4's and 2 by 6's as shown in Table 30. However, there was a significant increase in 8 inch and wider dimension during

TABLE 29. Percentage distribution of grades of 2 inch dimension lumber marketed by Arizona lumber producers, 1959-1965.

Grade	Per cent of 2" Dimension			
	1959	1961	1963	1965
Standard & Better	55.4	50.4	49.1	55.4
Utility	38.8	39.2	39.8	31.3
Economy	5.8	8.7	10.7	12.0
Other	-	1.7	0.4	1.3
Total	100.0	100.0	100.0	100.0

See Table 10, Appendix D.

TABLE 30. Percentage distribution of widths of 2 inch dimension marketed by Arizona lumber producers, 1959-1965.

Widths	1959	1961	1963	1965
6" and narrower	92.1	84.9	76.9	78.8
8" and wider	4.0	6.4	12.2	16.4
Random widths	3.9	8.7	10.9	4.8
Total	100.0	100.0	100.0	100.0

See Table 11, Appendix D.

the sample years; it increased from 4 per cent of all dimension in 1959 to 16 per cent in 1965.

4/4 to 8/4 lumber.--The proportion of lumber sold in fractional thicknesses of 4/4 to 8/4 (including 6/4 resawn) during the sample years varied from 40 per cent to 60 per cent of all lumber (Table 12, Appendix D). About 70 per cent of this classification of lumber was in the 6/4 thickness and 5/4 accounted for about 15 per cent as shown in Table 31. When 6/4 resawn is deducted from this

TABLE 31. Percentage distribution of thicknesses of 4/4 to 8/4 lumber marketed by Arizona lumber producers, 1959-1965.

Thickness (in inches)	% of 4/4 to 8/4 Lumber			
	1959	1961	1963	1965
4/4	10.0	6.3	4.5	5.1
5/4	15.2	14.8	15.8	20.7
6/4 (incl. RS)	68.7	76.4	74.2	68.4
Other	6.1	2.5	5.5	5.8
Total	100.0	100.0	100.0	100.0

See Table 12, Appendix D.

classification, 6/4 accounts for about 1/2 of the 4/4 to 8/4 lumber as indicated in Table 32.

About 1/2 of this classification of lumber was in the No. 3 Common and Poorer grade as shown in Table 33. The shop and select grades accounted for about 40 to 50 per cent and No. 2 Common and Better made up the remainder.

TABLE 32. Percentage distribution of thicknesses of 4/4 to 8/4 lumber (excluding 6/4 resawn) marketed by Arizona lumber producers, 1959-1965.

Thickness (in inches)	Per cent of 4/4 to 8/4 (excluding 6/4 resawn)			
	1959	1961	1963	1965
4/4	15.5	11.4	8.4	7.7
5/4	23.7	27.0	30.0	31.6
6/4 (excl. RS)	51.4	56.9	51.4	52.1
Other	9.4	4.7	10.2	8.6
Total	100.0	100.0	100.0	100.0

See Table 13, Appendix D.

TABLE 33. Percentage distribution of grades of 4/4 to 8/4 lumber (including 6/4 resawn) marketed by Arizona producers, 1959-1965.

Grade	% of 4/4 to 8/4 Lumber (including 6/4 resawn)			
	1959	1961	1963	1965
Selects	9.2	7.1	9.9	13.3
Shop	34.7	35.1	36.1	41.2
Commons:				
2 & Better	4.3	3.6	3.0	3.8
3 & Poorer	51.8	54.2	50.7	41.7
Mill Run	-	-	0.3	-
Total	100.0	100.0	100.0	100.0

See Table 14, Appendix D.

Table 34 shows the grades when 6/4 resawn is deducted from this classification. No. 3 Common and Poorer declined from about 30 per cent of all the 4/4 to 8/4 lumber in 1959 to about 15 per cent in 1965. As would be expected when most of the 1 inch lumber is removed from the fractional lumber, shop and select grades made up between about 70 to 85 per cent of the 4/4 to 8/4 lumber.

TABLE 34. Percentage distribution of grades of 4/4 to 8/4 lumber (excluding resawn) marketed by Arizona producers, 1959-1965.

Grade	% of 4/4 to 8/4 Lumber (excluding 6/4 resawn)			
	1959	1961	1963	1965
Selects	14.2	12.8	18.8	20.2
Shop	53.3	63.7	66.2	61.7
Commons:				
2 & Better	2.7	1.1	0.6	2.7
3 & Poorer	29.8	22.4	13.8	15.4
Mill Run	-	-	0.6	(a)
Total	100.0	100.0	100.0	100.0

[a]Less than 0.05 per cent.

See Table 15, Appendix D.

Widths of shop lumber are of less significance than in commons as the lumber is intended for manufacturing into component parts of other products. About 1/2 of all of the 4/4 to 8/4 lumber was sold in random widths. All

of the 4/4, 7/4, and 8/4 lumber was sold in random widths and almost all of the 5/4 was in random widths. Table 35 indicates the proportion of the various widths for 6/4 lumber. Random widths accounted for 1/3 to 1/2 of the 6/4 lumber (including 6/4 resawn) with 12 inch and 8 inch the 2 most important widths.

TABLE 35. Percentage distribution of widths of 6/4 lumber (including 6/4 resawn) marketed by Arizona producers, 1959-1965.

Widths	1959	1961	1963	1965
6" and less	10.2	6.8	7.6	5.0
8"	17.7	21.6	21.4	20.2
10"	8.5	5.2	2.6	3.4
12"	25.3	32.7	32.6	23.8
8 and 10"	1.9	0.7	1.1	1.7
Random widths	36.4	33.0	34.7	45.9
Total	100.0	100.0	100.0	100.0

Markets for Arizona Lumber

The findings of the survey as to the location of major markets for Arizona lumber and the destination by region of all lumber shipments for the study period are reported in this section. Also reported are the types of middlemen that purchased Arizona lumber and the transportation media used in moving the lumber to final buyers.

Major markets

Due to the lack of specific information about the marketing of Arizona lumber, the locations of the major markets for lumber produced in Arizona have not been known. This lack of knowledge has led to estimates that as much as 90 per cent of all Arizona lumber is exported to markets outside the state. This study discovered that 70 to 78 per cent was exported and 22 to 30 was shipped to destinations within the state during the survey years as shown in Table 36. This percentage is based upon the total quantity of lumber being shipped to final buyers. Almost 100 per cent of all the lumber sold is accounted for in the final buyer classification; the only lumber that is not included is the very small quantity (less than 1 per cent) sold for diversion without a destination listed on the invoice.

TABLE 36. Percentage of Arizona lumber exported from and retained in Arizona, 1959-1965.

Destination	1959	1961	1963	1965
Exported from Arizona	71.8	78.0	70.5	75.7
Shipped to buyers in Arizona	28.2	22.0	29.5	24.3

The percentage of all lumber shipments going to each state for each of the sample years was determined.

During the sample period, 31 states, Canada, and Mexico received shipments of Arizona lumber. As many of the states received only very small quantities, no complete listing by states is presented. Table 37 lists the 11 states that accounted for about 85 per cent of all lumber exported from Arizona.

TABLE 37. States as major markets for Arizona lumber by percentage of total board feet exported, 1959-1965.

State	1959	1961	1963	1965
Texas	11.8	18.4	17.9	17.9
New Mexico	7.1	11.7	15.6	17.4
California	8.5	7.1	10.8	9.6
Illinois	14.5	9.0	7.4	7.2
Ohio	10.7	9.4	7.0	7.0
Michigan	12.7	9.6	6.8	6.7
Oklahoma	1.8	2.4	4.7	5.2
Missouri	3.2	4.9	4.3	4.0
Utah	9.4	7.7	3.0	3.6
Indiana	3.4	4.3	3.0	2.9
Tennessee	2.1	3.0	4.7	2.3
Total	85.2	87.5	85.2	83.8

A more meaningful presentation is to show the percentage of Arizona lumber going to the various regions of the nation. For comparison purposes, the composition of each section and region is the same as that used in Timber Trends in the United States.[4] This division of states

[4]U. S. Forest Service, Timber Trends in the United

into regions is shown in Appendix B.

The destination by region of all lumber exported from Arizona during the sample period is shown in Table 38.

TABLE 38. Destination of lumber exported from Arizona, by region, by per cent of total board footage exported by Arizona lumber producers, 1959-1965.

Region	1959	1961	1963	1965
Central States	36.9	32.5	24.6	25.0
West Gulf	13.6	23.1	23.7	24.0
Southern Rocky Mountain	20.2	22.0	24.3	22.1
Pacific Southwest	8.5	7.1	10.8	9.6
Lake States	14.9	10.2	7.3	7.2
Central Gulf	2.6	4.2	6.2	4.9
All other regions	3.3	0.7	2.0	4.8
Foreign export	-	0.2	1.1	2.4
Total	100.0	100.0	100.0	100.0

See Table 18, Appendix D.

The Central States region of the United States was the leading area although it showed a steady decline during the survey period. The West Gulf region was second; it showed a steady increase and nearly equalled the Central States in 1965. The next most important area was the Southern Rocky Mountain Region with a rather constant 22 per cent.

The relative importance of the Southern Rocky

States, Forest Resource Report No. 17 (Washington: U. S. Government Printing Office, 1965).

Mountain region is reduced in Table 38 as it reports only lumber exported from the state. When the lumber retained in Arizona is added to the total for the Southern Rocky Mountain region, this area becomes most important of the markets for Arizona lumber as indicated in Table 39.

TABLE 39. Destination of all lumber shipments by region, in per cent of total lumber marketed by Arizona lumber producers, 1959-1965.

Region	1959	1961	1963	1965
Southern Rocky Mountain	42.7	39.3	46.7	41.0
Central States	26.7	25.2	17.4	19.0
West Gulf	9.8	18.1	16.6	18.2
Pacific Southwest	6.0	5.5	7.6	7.2
Lake States	10.7	8.0	5.2	5.3
Central Gulf	1.8	3.2	4.4	3.7
All other regions	2.3	0.6	1.3	3.8
Foreign export	-	0.1	0.8	1.8
Total	100.0	100.0	100.0	100.0

See Table 19, Appendix D.

Lumber exported from Arizona.--Table 36 indicates that about 1/4 of all Arizona lumber was sold to buyers in Arizona. It is revealing to compare the types of lumber exported from Arizona with the types shipped to final buyers within the state; there are significant differences in several of the categories.

As the sample data for 1965 represents almost all of the state's production, it was decided to use that year

for the comparison of the types of products exported from the state with the types retained in the state. The degree of accuracy of these data should be high as they represent about 348,000,000 board feet of the 365,000,000 board feet produced in 1965. In 1965, about 1/4 of all the lumber marketed (88,750,000 board feet) was shipped to buyers in the state.

Table 40 indicates that there was a significant difference in the proportion of commons retained in and exported from the state. About 50 per cent of the lumber

TABLE 40. Comparison of types of lumber, by general quality classification, exported from and retained in Arizona, 1965.

Grade Classification	% of all lumber retained in Arizona	% of all lumber exported from Arizona	% of all lumber marketed by Ariz. prod.
Selects	6.3	7.4	7.0
Shop	23.8	19.7	20.8
Commons:			
Boards	27.3	49.4	44.2
Dimension	42.6	23.5	28.0
Total	100.0	100.0	100.0

See Table 20, Appendix D.

exported was 1 inch commons; of the lumber retained in the state only 27 per cent was of this classification. Dimension accounted for about 1/4 of exported lumber but

it was 43 per cent of the lumber shipped to Arizona buyers. Differences in the other grades were small. However, it should be pointed out that there was a difference in the factory and shop classification; shop accounted for a higher percentage of retained lumber than of exported lumber.

Although dimension 3 inches and thicker accounted for 5.3 per cent of retained lumber, it was only 0.3 per cent of exported lumber (Table 20, Appendix D). About 1/2 of this class was sold as "mine lagging" or "mine timbers." Two inch mine lagging also accounted for 3.8 per cent of the lumber sold to Arizona buyers; no 2 inch lagging was exported. Mine timbers and lagging represented 6.5 per cent of all the lumber retained in Arizona; it accounted for only about 0.1 per cent of exported lumber.

Table 41 shows some other significant differences between exported lumber and lumber retained in the state. Eighteen per cent of all the lumber retained in Arizona was green lumber; of all lumber exported, only 7.1 per cent was green. Unsurfaced lumber accounted for 14.8 per cent of the lumber shipped to Arizona buyers in comparison to only 4.5 per cent of exported lumber being unsurfaced.

A very important difference is shown in the proportion of exported lumber being resawn lumber as compared to the lumber retained in the state. Twenty-two per cent of exported lumber was resawn; only 6.3 per cent of the lumber

TABLE 41. Comparison of Arizona lumber exported from and retained in Arizona, by various classifications, 1965.

Classifications	% of All Lumber Marketed by Ariz. Prod.	% of All Lumber Exported from Ariz.	% of All Lumber Retained in Arizona
Moisture content			
Green	9.9	7.1	18.4
Dry	90.1	92.9	81.6
Total	100.0	100.0	100.0
Surfacing			
Unsurfaced	7.1	4.5	14.8
Surfaced	92.9	95.5	85.2
Total	100.0	100.0	100.0
Resawn lumber			
Resawn	18.2	22.1	6.3
Not resawn	81.8	77.9	93.7
Total	100.0	100.0	100.0
Pattern			
Not patterned	94.6	93.8	97.2
Patterned	5.4	6.2	2.8
Total	100.0	100.0	100.0
Species			
Ponderosa pine	87.6	89.8	80.7
Douglas-fir	7.2	5.7	11.8
White fir	5.1	4.3	7.5
Mixed species	0.1	0.2	-
Total	100.0	100.0	100.0

retained in Arizona was resawn. There was only a small difference in the percentage of patterned lumber exported as compared to the percentage of patterned lumber retained in Arizona.

A surprising difference occurred in the relative proportion of ponderosa pine lumber exported as compared to the percentage retained in the state. Almost 90 per cent of all lumber exported was ponderosa pine; only 81 per cent of the lumber retained in Arizona was pine. A larger percentage, almost 12 per cent, of the lumber retained was Douglas-fir as compared to only 5.7 per cent of exported lumber being Douglas-fir. White fir was also a greater proportion of retained lumber than it was of exported lumber.

Types of buyers

To present a comprehensive report on the marketing of Arizona lumber it was necessary to determine what types of middlemen purchased Arizona produced lumber. It was possible from the sales invoices to classify the types of middlemen that bought lumber from Arizona producers during the study period by reference to the Red Book as explained in Chapter III.

Two general types of classifications were used to identify the firms. The first classification has reference to whether 1 or 2 buyers were listed on the invoice. When

an invoice listed only 1 buyer with shipment to that buyer, the firm was identified as a "final buyer."

Many invoices indicated 2 buyers, 1 under the heading of "Sold to" and the second under the heading of "Ship to" or "For delivery to," in these cases firms listed under the heading of "Sold to" were identified as "intermediate buyers," and those listed under the "Ship to" heading were classified as "final buyers." In other words, the classification of final buyer is inclusive of almost all of the buyers receiving shipments of Arizona lumber.

In a few cases, invoices indicated only 1 buyer with the notation of "for furtherance" or "for diversion." This terminology is used when a wholesaler has ordered a rail car of lumber but has no final buyer at the time the order is placed. The wholesaler plans to locate a buyer before the rail car reaches the diversion point so that the railroad can be informed of the final destination. The buyers listed on these invoices are classed as intermediate buyers and no final buyers are identified. This occurred on less than 0.5 per cent of the invoices.

Table 42 indicates that about 39 per cent of all Arizona lumber was sold through intermediate buyers and about 61 per cent went directly to final buyers in 1959, 1961, and 1965. In 1963, about 30 per cent was sold through intermediate buyers and 70 per cent was sold directly to final buyers. In general, the intermediate

buyers are responsible for rail shipments going to the Midwest and South. Most lumber sold in Arizona goes directly to final buyers.

TABLE 42. Percentage distribution of lumber sold through intermediate buyers and directly to final buyers, 1959-1965.

Type of Buyer	1959	1961	1963	1965
Sold through intermediate buyers	39.1	39.3	30.3	37.7
Sold directly to final buyers	60.9	60.7	69.7	62.3

The second classification divides buyers into the several types of middlemen and other classes of buyers active in the forest products industry. Table 43 indicates the percentage of Arizona lumber going to the various types of final buyers during the survey years. In 1959, 1961, and 1963, retail lumber yards received about 45 to 50 per cent of all lumber; in 1965 they received only 40 per cent. The amount going directly to wholesalers varied from 14 per cent in 1959 to about 25 per cent in 1963. Wood products manufacturers were the recipients of as much as 1/3 of all lumber in 1959; this dropped to a low of 20 per cent in 1963 and was about 25 per cent in 1965.

Table 44 indicates the relative importance of the various types of middlemen in the intermediate buyer

TABLE 43. Relative importance of final buyers of Arizona lumber, by per cent of board footage sold to each type, 1959-1965.

Type of Buyer	1959	1961	1963	1965
Lumber wholesaler	14.3	21.7	25.7	20.6
Retail lumber yard	44.4	49.1	46.5	39.1
Wood products mfr	33.8	23.9	20.5	24.8
Other	7.5	5.3	7.3	15.5
Total	100.0	100.0	100.0	100.0

See Table 16, Appendix D.

classification. As would be expected, wholesalers were involved in the sale of about 3/4 of all lumber sold through intermediate buyers. Buyers listed as retail yards or building supply dealers accounted for up to 9 per cent of all lumber sold through intermediate buyers. The remainder involved only small quantities divided among several other types of buyers, many of them combined wholesale and retail operations.

It was not possible to determine what percentage of the lumber was sold through brokers. A sales invoice does not normally list the broker that has arranged the sale; the mill bills the final buyer directly and pays the broker a commission on the sale. It is probable that much of the lumber sold directly to retail yards, especially those located outside of Arizona, was sold through brokers.

TABLE 44. Relative importance of intermediate buyers of Arizona lumber, by per cent of board footage sold through each type, 1959-1965.

Type of Buyer	1959	1961	1963	1965
Wholesaler	71.3	78.2	69.3	72.9
Combination whlslr, retailer, & remanufacturer	12.6	14.9	15.6	10.0
Retail lumber yard or building supply	9.5	2.5	5.3	8.8
Combination whlsle & retail	3.2	1.8	5.3	1.9
All other	3.4	2.6	4.5	6.4
Total	100.0	100.0	100.0	100.0

See Table 17, Appendix D.

It would be desirable to determine the types of end users of Arizona lumber. It was, of course, impossible to determine this from the sales invoices. During the interviews, executives were asked to estimate the percentage of Arizona lumber going into construction, into industrial usages, and to remanufacture. In general, it was the concensus that a decade ago (1956-1957) about 75 to 80 per cent of all Arizona lumber (including shop lumber) went into construction with the remainder going to industrial users and to manufacturers of wood products for other than construction purposes. In 1966, it was estimated that only about 40 per cent of Arizona lumber went directly into construction. The remaining 60 per cent was going to industrial users and to manufacturers of both

construction items and non-construction products (such as furniture).

Method of transportation used.--As shown in Table 45, truck and rail shipments were about equally divided in 1959 and 1961. In 1963 truck shipments

TABLE 45. Method of transportation used for Arizona lumber shipments, 1959-1965.

Method of Transportation	Per cent of Total			
	1959	1961	1963	1965
Truck	50.4	51.8	60.7	57.4
Rail	49.6	48.2	39.3	42.6

increased to about 60 per cent and rail shipments dropped to about 40 per cent of total shipments. In 1965, truck shipments accounted for 57 per cent and rail for 43 per cent of all shipments. No rail shipments were made within the state and trucks accounted for most of the lumber going to Los Angeles and all of the lumber going to Las Vegas and Salt Lake City. About 1/2 of the lumber going to Albuquerque and El Paso was shipped by truck. The quantities shipped by truck to other areas in the Southwest were dependent upon the mill making the sale. Some ship into that area almost exclusively by truck; other mills use rail for most of their shipments. Only an occasional

truck shipment was made further east than the Mississippi River; 700 to 800 miles appeared to be the maximum trucking distance. The importance of freight costs in lumber marketing and the impact of rate changes are discussed in the next chapter.

CHAPTER V

PERFORMANCE OF MARKETING FUNCTIONS

This chapter presents a report on the performance of the marketing functions by Arizona lumber producers. The information for this report was obtained through interviews with management personnel from the firms included in the survey as explained in Chapter III. In contrast to the data presented in the preceding chapter, the following report is not quantitative in nature as most of the information is not of the type that can be meaningfully expressed in numbers. Where pertinent, comparisons are made to other firms and other regions in an effort to indicate how the Arizona industry conforms to or differs from the remainder of the lumber industry.

The writer's intention here is to synthesize information gathered from the interviews into a general description of the marketing activities performed by Arizona lumber producers. Where significant differences in the manner of performing the functions occurred among the firms, care has been exercised so as not to disclose proprietary or confidential information about individual firms.

Pricing

Price trends.--As discussed in Chapter II, the lumber producing industry is frequently cited as an example of the traditional economic concept of a competitive industry. As no one firm or small group of firms control a large enough portion of the total quantity of lumber offered for sale to affect price, the price at any given time is determined by the relationship between supply and demand. The variables acting on both the supply and the demand sides are numerous and complex and there is no need here for a comprehensive examination of lumber prices. However, there is a need to examine general price levels and trends during the period covered by the study and the relationships between the prices of the various types and grades of lumber.

A discussion of lumber prices is not a simple task as a typical price sheet will list different prices for each species of lumber in each thickness, each width, each grade, and for various lengths. The table of lumber sizes in Appendix E gives an indication of how many variations are possible. When prices are quoted for each grade of each species, the number of prices becomes too large to discuss with clarity; the discussion must be restricted to specific items. In other words, there are so many variables involved that it is not possible to speak of the price of 2 by 4's; the price must be qualified by speci-

fying the dressed thickness, the length, the species, the grade, the surfacing, and the moisture content.

The best solution in a discussion of lumber prices is to resort to "average" prices, despite their ambiguity. Fortunately, the Bureau of Labor Statistics' montly publication, Wholesale Prices and Price Indexes,[1] lists the mean prices for 5 types of lumber produced in Arizona: No. 3 and No. 4 Common ponderosa pine boards, No. 2 ponderosa pine Shop, Standard and Better Douglas-fir dimension, and Standard and Better white fir dimension. These prices are the arithmetic means of the FOB mill prices for a month for all variations of the specified items. Table 8 in Appendix C gives a complete listing of these monthly prices for the 7 years covered by this study.

In order to make a graphic presentation of the prices, quarterly averages were computed from the monthly data for the 3 most important series. These quarterly averages are shown in Figure 2. It is apparent from this graph that the prices for ponderosa pine commons were depressed for most of the study period. This is indicated more specifically in Table 9, Appendix C, which presents a complete listing of the monthly indexes of these average prices based on the mean prices for the items during the

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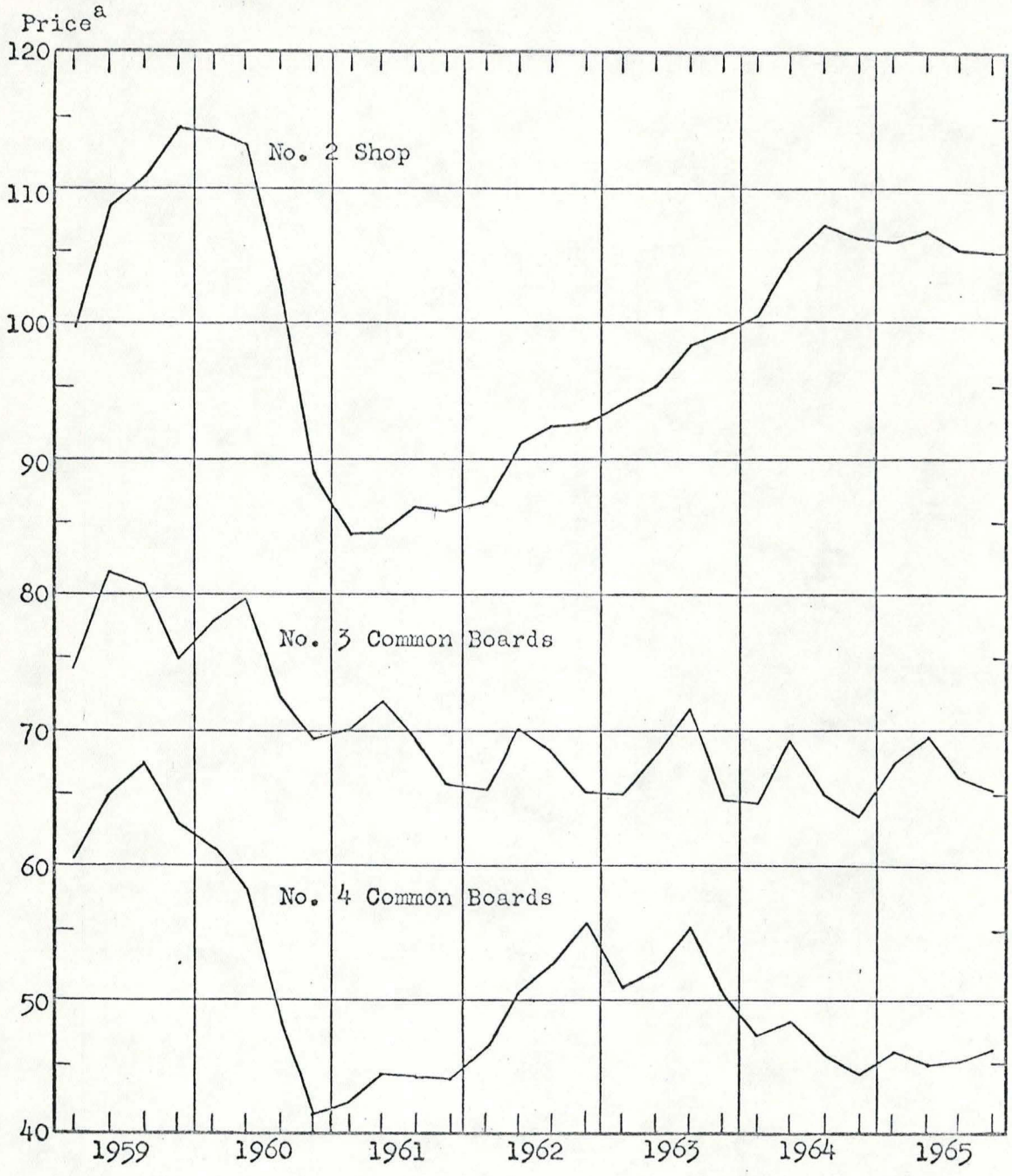
[1]U. S. Bureau of Labor Statistics, Wholesale Prices and Price Indexes (Washington: U. S. Government Printing Office, issued monthly).



[a]Price in dollars per thousand board feet of lumber.

Figure 2.--Mean quarterly FOB mill prices for selected grades of ponderosa pine lumber. (Source: Table 8, Appendix C)

base period of 1957 through 1959. For example, the average price for No. 3 Common for December, 1965, the last month of the study period, was 12.7 per cent below the average price for the base period; No. 4 Common was 25.9 per cent below the base period price. In contrast, No. 2 Shop was 3.5 per cent above the average price for the base period, indicating a relatively strong demand for this item. The demand for dimension also remained strong as indicated by an index of 106.8 for Standard and Better Douglas-fir in December, 1965.

A careful perusal of these price indexes reveals a varying degree of seasonality in the different series. The interviews indicated that seasonal fluctuations were not considered an important factor in lumber marketing and no attempt has been made, therefore, to determine the seasonality of the various series.

Table 46 gives a more complete idea of the price relationships between the various kinds of lumber produced in Arizona. Listed in the table are the current prices (April, 1967) for selected products representative of items produced in Arizona. As indicated in Figure 2, these relationships change over time depending upon the supply and demand situation; Table 46 indicates only the differences between the various items in April, 1967. It is obvious that the low prices for No. 3, No. 4, and No. 5 Common boards and the Utility and Economy grades of

TABLE 46. Prices (FOB Mill) for selected ponderosa pine lumber[a] items, April, 1967.

Grades of Lumber	Price per Thousand Board Feet for Sizes Indicated	
Selects	1 x 8	6/4 x RW[b]
C and Better	$265	$280
D	165	190
Moulding	145	185
Shop	4/4 x RW[b]	6/4 x RW[b]
No. 3 Clear	$103	$167
No. 1	78	135
No. 2	58	97
No. 3	-	73
Commons	1 x 8	6/4 x 8 RS[c]
No. 2	$ 88	-
No. 3	62	$ 73
No. 4	47	60
No. 5	26	34
Dimension	2 x 4	2 x 6
Standard and Better	$ 66	$ 61
Utility	49	47
Economy	26	26

[a]Surfaced, kiln dried, and random lengths

[b]Random widths

[c]Resawn

Sources: Compiled from personal interviews, price lists, and Crow's Price Reporter (Portland, Oregon: C. C. Crow Publications, Inc.), April 28, 1967.

dimension are cause for real concern to the industry, especially as these grades account for over 50 per cent of the total lumber produced in the state (Table 20, page 93).

Competitive situation.--Although the number of firms in the industry in Arizona is not large and there is a high degree of concentration in the ownership of the large volume mills, the Arizona industry faces a highly competitive situation; Arizona firms must compete for markets for their lumber with the tens of thousands of other lumber producers located throughout the nation. The products produced by Arizona mills are not unique; the same types of products are produced by mills located in most parts of the United States. Although Arizona ranked nineteenth in the nation in the volume of lumber produced in 1964,[2] the state's production accounted for only 1.1 per cent of the nation's total lumber production that year. Obviously Arizona firms have competition from other lumber producers.

In situations of this type, the demand curve for the output of an individual mill is perfectly elastic. In a thorough study of competition in the Douglas-fir lumber industry, Walter J. Mead states: "We find that individual firms, even the largest, face a perfectly elastic demand

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[2]National Forest Products Association, Forest Products Industry Facts, 1966 (Washington, D. C.: National Forest Products Association, 1966), p. 10.

curve for their lumber . . ."[3] Theoretically, this means that a mill could sell any quantity of lumber it could supply at (or below) the market price but could not sell any above that price. This type of situation emphasizes the importance to an individual lumber firm of complete and immediate knowledge of market prices in all the markets in which it chooses to sell.

The demand curve apparently has width (goods exchanged at prices deviating slightly from the market price), however, as Arizona firms sold at prices both above and below the market price. There are 2 possible reasons for such deviations from market prices. First, imperfect knowledge of the market price at any given time could cause either a buyer or a seller to be pricing above or below the market price. Secondly, sellers could (and did) price both above and below the market price in order to control to some extent the quantities of given items that would be sold. When a firm determined that it was developing a shortage in a given item, it would raise the price for that item though there was no indication that there was an upward trend in the price for that product. If it developed that there was a general shortage of and a strong demand for the item, the mill would be ahead of the gen-

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[3]Walter J. Mead, Competition and Oligopsony in the Douglas Fir Lumber Industry (Berkeley: University of California Press, 1966), p. 1.

eral price rise and would then attempt to produce larger quantities of the product. If the situation was only a short-run demand for the item, the higher price would reduce the number of orders for the product, relieving pressure on the mill to produce more of the item.

On occasion, a surplus may develop in a given product. As the nature of the lumber production process requires the continued production of at least some proportion of the surplus item, the surplus has to be reduced because of storage limitations. It is common practice for a mill in such a situation to set its price below the market price in order to sell larger quantities of the item. As soon as the surplus is eliminated, the price is again raised to the market price.

In his study of the Douglas-fir region, Mead found that prices deviated from the market price for the 2 reasons cited above.[4] In a study published in Northern Logger, Wynd reports that small buyers are often penalized by inadequate knowledge of market prices in contrast to larger buyers who are usually better informed as to current prices.[5] He also points out that the small seller is not in contact with as many potential buyers and, consequently, does not have full knowledge of the market. Wynd indicates

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[4] Ibid., pp. 129-130.

[5] William R. Wynd, "Marketing Aids for the Lumber Industry," Northern Logger, (May, 1965), p. 22.

that the problem for the small operator is largely one of communication.

This was true for the smaller Arizona firms. Some of the small mills relied heavily upon a few buyers and made no attempt to expand their sales by contacting other potential customers. In contrast, the larger producers made an effort to sell in every market where they could compete successfully with mills from other parts of the nation. Through their daily contacts with their regular distributors in many areas, the large firms were able to keep abreast of the fluctuations in demand from area to area.

Price information.--As there is no organized exchange or market for lumber (such as the commodity exchanges for agricultural products), sawmills must rely on various types of market intelligence to determine prices in various markets. As indicated above, Arizona mills compete in markets in most of the major population centers in the Midwest and South and it is essential that they know the market prices in those markets if they are to price their products competitively.

Three basic sources of price information were utilized by Arizona firms: direct mill salesmen maintained by individual firms in various major markets; distributors (wholesalers) in the important markets; and market information sources such as Random Lengths, Crows, and the Western

Wood Products Association.

The extent of the use of branch sales offices, direct mill salesmen, and wholesale distributors is discussed below in the section on sales organization. These sources provided valuable, accurate, and immediate market information to the home office. The telephone was used for contact between the sales manager and the salesmen and distributors. As one sales manager said, "We live with these sources on that phone!" Teletype was not used to any extent to contact field sources.

The market information publications are good sources of price information; however, there is a lag in the time period as they do not publish daily price data. Random Lengths and Crows are weekly publications with price information for the prior week; the Western Wood Products Association's information is 3 weeks late as it is based upon sales invoices submitted by member firms.

Price decisions.--With information from these sources and knowledge of the firm's inventory, prices were established at which the firm would offer its various products for sale. However, it was difficult to determine precisely who had the authority for pricing decisions in the various firms. The common response from sales managers was that "We're competitive and will meet going prices." This indicated that the sales manager had pricing authority on a day-to-day basis, at least within limits. There were

strong indications that major shifts in prices involved many, if not all, of top management. In general, the price decision maker for moderate price changes was the owner or general manager in small firms and the sales manager or wood products division manager in the larger firms.

Price dissemination.--Some of the mills issued price sheets listing their prices on the various types of lumber. These lists were up-dated as changes in prices became significant. To supplement their regular price lists, some mills mailed weekly "offering sheets" to their regular wholesalers listing items available for immediate shipment, frequently at a price somewhat lower than the price on the regular price sheet. Through this communication medium, wholesalers were kept advised of stock available for shipment and mills could more readily move items in which they were getting overstocked. Price dissemination is discussed in additional detail below in the section on sales procedures.

Discounts.--It was common practice for lumber producers to sell to retail lumber yards at the current "list" price, i. e., the price stated in the price list or offering sheet, and to grant wholesalers a trade discount of 5 per cent of the list price. This discount was granted only to firms performing the wholesale function of carload purchases of lumber for resale to retail yards. The mills

were careful to determine the status of new buyers before granting the trade discount. A new buyer whose status was unknown was investigated, primarily through the Lumbermen's Credit Association and its Red Book reference service, before being granted the trade discount.

The trade discount applied only to the net value of the lumber on the invoice; i.e., the discount was not applicable to the freight costs which were usually included on the invoice. As the normal procedure was to sell on a delivered price basis, this procedure was the cause of some confusion. Many invoices examined by the writer had letters attached indicating that the buyers had not taken the proper discount. The extent of this confusion was not determined as some firms did not file their correspondence with the sales invoices.

Lumber brokers arranging sales to retail yards were paid a 3 per cent commission by the mill on the net value of the lumber. Brokers were not involved in sales to wholesalers, preventing the combination of a trade discount with a commission. In broker-arranged sales, the mill billed the final buyer directly; the broker neither collected from the buyer nor paid the transportation company.

In addition to trade discounts, it was common practice for the producers to grant buyers a discount for payment within a specified time. Although the terms

varied, the usual discount was 2 per cent for payment within 10 or 15 days after either the date of the invoice or the receipt of the lumber. The full amount of the invoice was due within 30 days of the date of the invoice if advantage was not taken of the cash discount. This cash discount was allowed on the net amount of the invoice after deductions of freight costs and trade discounts. Again, this procedure appeared to be the cause of some confusion. One sales manager estimated that he spent 20 per cent of his time on credit and collection problems. These problems concerned disagreements over terms, as well as the investigation of new accounts and the collection of delinquent accounts. Another of the larger firms placed the collection function in the controller's department; the sales department did not become involved in disputes over terms or the collection of delinquent accounts.

Freight costs.--As about 75 per cent of all Arizona lumber was shipped out of state, freight rates were an important part of the price structure. In a strict sense, all lumber prices are FOB mill; the buyer pays the transportation company. In practice, delivered prices are quoted for all shipments going by rail or by sawmill-owned trucks. It would be very difficult for a buyer in Chicago, for example, to determine the cost of lumber delivered to him if he had to compare FOB mill prices from mills in several states and then determine freight costs from each

of the areas. In the case of rail shipments, the buyer pays the railroad company and deducts the freight costs from the invoice amount prior to making payment to the mill for the lumber.

No truck shipments by common carrier were discovered on the invoices examined by the writer. Two of the large firms operated their own truck fleets and made deliveries to destinations as much as 800 miles from the mills. Mills located at some distance from a railhead preferred to use truck shipments whenever possible to avoid the problems of reloading onto rail cars. Other shipments going by truck were loads picked up at the mill by customers' trucks. Although some buyers in Utah and New Mexico provided their own transportation, this was limited primarily to Arizona customers.

The use of delivered prices resulted in different net prices for mills located at varying distances from given markets. For example, Arizona had a freight rate differential in its favor over mills in the Pacific Northwest in shipping to the Central States region. Arizona mills netted nearly $7.00 per thousand board feet more for a rail car of pine commons shipped to Chicago than did mills in Oregon and Washington. The rate per 100 pounds from Flagstaff to Chicago, for example, was $1.15 (Table 47)

TABLE 47. Freight costs for rail shipments of lumber from Flagstaff, Arizona, to selected cities, December 31, 1965.

Destination	Rate per Hundred Pounds[a]	Freight Cost per Thousand Board Feet[b]	Delivered Price, No. 5 Common[c]
El Paso, Texas	$0.465	$ 8.835	$34.84
Lubbock, Texas	0.575	10.925	36.93
Oklahoma City, Okla.	0.84	15.96	41.96
Dallas, Texas	0.98	18.62	44.62
St. Louis, Mo.	1.08	20.52	46.52
Memphis, Tennessee	1.11	21.09	47.09
Little Rock, Ark.	1.14	21.66	47.66
Chicago, Illinois	1.15	21.85	47.85
New Orleans, La.	1.16	22.04	48.04
Detroit, Michigan	1.20	22.80	48.80
Jackson, Miss.	1.43	27.17	53.17
Birmingham, Ala.	1.54	29.26	55.26
Atlanta, Georgia	1.57	29.83	55.83
Jacksonville, Fla.	1.59	30.21	56.21

[a]Basic rate without incentive loading, special car, or combination rates.

[b]Based on ponderosa pine 1 by 8 boards, kiln dried, surfaced 4 sides, at an estimated weight of 1,900 pounds per thousand board feet.

[c]Based on an estimated FOB mill price of $26.00 (Table 46).

Source: Letter from Frank L. George, Freight Traffic Manager, The Atchison, Topeka and Santa Fe Railway Company.

compared to $1.51 from Spokane to Chicago.[6] On a shipment of lumber averaging 1,900 pounds per 1,000 board feet, the difference in freight costs was $6.84 per thousand board

[6]Information provided in a telephone conversation with the freight rate department at the main office of the Union Pacific Railroad Company, Los Angeles.

feet of lumber.

As freight rates varied considerably between various locations, the rate differentials between Arizona and the Northwest mills determined where Arizona mills concentrated their selling efforts. Logically, they attempted to sell in markets where the freight rate differential gave them an advantage over mills in the Pacific Northwest. A change in rate schedules resulted in a change in marketing efforts. Arizona mills obtained an added advantage over Oregon and Washington firms in sales in the Central Gulf region when freight rates from Arizona to that area dropped by several cents per 100 pounds.[7]

Table 47 shows the commodity rail freight rates for lumber from Flagstaff to 14 destinations as of December 31, 1965. As rail rates are very complex, Table 47 is simplified by showing only the basic commodity rate to the cities indicated. From this table it is obvious that freight costs are an important part of the delivered cost of lumber, especially in the lower grades that are predominant in Arizona production. In the grades that sold for $25.00 to $30.00 per thousand board feet (No. 5 Common boards and Economy dimension), the freight cost was as much as the product cost in shipments to many of the

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[7]Information provided by executives of 2 lumber firms and in a letter from Frank L. George, Freight Traffic Manager, The Atchison, Topeka and Santa Fe Railway Company.

areas. This is one of the important reasons that the lower grades of lumber were considered a serious problem by the Arizona industry.

Milling-in-transit rates provide the opportunity for a buyer to have products processed at some in-between location and the finished product shipped on to the final location. On the sales invoices examined during the study, there was no indication that milling-in-transit was used. Executives were asked during the interviews about the extent of this procedure and if it were an aid to sales. It was estimated that less than 5 per cent of Arizona lumber shipped out of state used the milling-in-transit privilege. This rate applies only to factory and shop lumber sold on a through rate to an eastern destination and these types of shipments did not account for a very large proportion of Arizona lumber sold during the study period.

Sales effort

It is difficult to make a detailed report of the organization of the selling effort of the various Arizona lumber firms for 2 reasons. First, the selling effort was devoted almost exclusively to the dissemination of information to possible buyers about items available for sale. Buyers were informed by mail as discussed above and by telephone calls from mill salesmen. In contrast to the

normally expected pattern of personal calls by salesmen, direct mill salesmen made their contacts primarily by telephone. As one salesman commented, "I wear out the seats of lots of trousers, but I don't wear out many shoes!"

The second reason that it is difficult to explain the organization of the selling effort is that the sales departments of the various firms were not only different, they all changed their organizational structures during the period covered by the study. Executives tended to respond to the researcher's questions about sales organization in terms of the current organization; it was at best difficult and frequently impossible to determine what the sales department's organization was in a firm at any given time during the years covered by the study. The following is based upon the situation as it existed in 1966 with mention of changes that had occurred when information about such changes was available.

Sales organization.--As expected, the organization of the sales departments of the firms varied in accordance with the size of the firm. With one exception, each of the larger firms had a senior executive responsible for the firm's sales efforts. The title of this senior executive varied from firm to firm. The title of vice president of marketing was used in only one firm for this executive; other titles were executive vice president, wood products division manager, and sales manager. Each of these firms

had a sales manager responsible to the senior executive for the operation of the sales department. These sales managers had from 1 or 2 to 10 or 12 salesmen reporting to them. The numbers of and the field locations of these salesmen changed from time to time depending upon the market situation and current management procedures. One or more of the firms maintained direct mill salesmen at some time during the study in these cities: Phoenix; Los Angeles; Lubbock, Texas; Denver; Wichita, Kansas; Albuquerque, New Mexico; Chicago; and Salt Lake City.

The exception to this general pattern among the larger mills was a mill that used an exclusive sales agent (a wholesaler) rather than maintaining a sales department. The sales agent had total responsibility for the firm's sales and was on a commission basis. Two or 3 salesmen in various locations were maintained by the sales agent.

In the smaller firms, the owner, the general manager, or the office manager was the person responsible for the firm's sales. Several of these mills relied heavily upon a few major customers to purchase the bulk of their output. There did not appear to be contractual agreements in these arrangements; they were more a traditional and informal "gentlemen's agreement."

Selling activities.--As mentioned above, most sales were negotiated over the telephone. It was difficult

to determine which party, the buyer or the seller, initiated the sales interview. The salesmen contacted customers regularly by telephone, especially when the mill was approaching an overstocked position on certain items. However, many sales were initiated by the buyer, again by telephone, when he was in need of a shipment of a certain item or items. The day-to-day market situation appeared to be the determining factor.

In addition to contacting customers, direct mill salesmen provided current market information to their sales managers. There was evidence to indicate that mills with direct mill salesmen were better informed of the market situation in the various markets than were the smaller mills without salesmen in the field.

The approach to the sales effort described above is common with most of the lumber producers throughout the United States. Mead states: "First, both lumber producers and wholesalers send prospective buyers an offering list. . . . From this point on, most lumber is sold over the telephone . . ."[8] He goes on to state that some large firms maintain sales forces to contact customers. The general attitude is that lumber is a commodity and that lumber firms are engaged in the production of lumber, not the marketing of lumber products. With this commonly

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[8]Mead, op. cit., p. 128.

accepted approach to the sales effort, the Arizona firms showed little interest in or need for large departments with salesmen personally contacting potential customers.

Product sales approach.--Other approaches to the marketing of lumber have been attempted by some firms. Dr. Stuart Rich, Director of the Forest Management Research Center at the University of Oregon, cites examples of successful lumber companies that have changed to a product approach in their sales efforts, even though they were selling a commodity. A description of product sales management in 2 of these firms is presented here to emphasize the difference between commodity selling as practiced by most lumber firms, including those in Arizona, and successful applications of a product sales orientation:

Company A: Product Management and Commodity Selling (Lumber and Plywood Division)

Company A, even though it sells mainly lumber and plywood commodity items, has been able to secure a higher profit realization from its product line than many other companies selling supposedly identical items. Careful attention to product management and market management is an important reason for its success.

Production scheduling and sales control, which are the main parts of the product management function at Company A, are handled by the Lumber and Plywood Sales Control Managers at company headquarters, assisted by Regional Sales Control Managers. Close cooperation exists between Sales Control and the Sales and Manufacturing Departments. Salesmen, for example, besides having the usual stock and price lists, are furnished with up-to-date figures on mill profits on different items. Thus they know when it may be desirable to take a loss on some items in a mixed carload shipment and to get a higher price on other items in

order to maximize profit on the total order. Sales control also meets periodically with mill managers to review sawing practices and to make changes to improve profit realization from each log.

Market management, handled by the Sales Promotion Manager, is based on a good system of market intelligence. Weekly reports are made on such things as sales realization by area and product type, performance of wholesalers, and market trends affecting product and distribution policies. Based on these reports, the company has been able to upgrade its commodity selling by offering certain product and service "extras" to particular customers willing to pay higher prices for them.

Company B: Product Management and Sales Force Management (Lumber, Plywood, and Panel Products)

Company B sells both commodities and products and is also moving into systems selling. The product managers in this company are not only responsible for production scheduling, but are also deeply involved in the day-to-day activities of directing the field sales effort. Their role is viewed as that of re-establishing central control over the activities of a sales force which had previously been highly decentralized on a mill or area basis. These product managers carry the titles, Sales Manager, Lumber, Sales Manager, Plywood, and so on. They have functional authority over the field salesmen in matters regarding their particular product line, as compared with the Regional Sales Managers who have administration authority. The Product Sales Managers, for example, direct the salesmen in their efforts to get new business or to sell a more profitable product mix within lumber, or plywood, or hardboard lines. The product managers also make up a master production schedule for all the mills. Guided by this schedule, area sales coordinators approve customer orders and place them with particular plants.

Dealer advertising programs, new product promotion, market research, and other market management activities come under the Director of Market Development. These activities are particularly important as the company moves away from the commodity selling into

the marketing of products and systems.[9]

The purpose of this presentation is to indicate that the marketing of lumber can be organized on a product basis. There was evidence that 2 or 3 of the companies included in this study were beginning to break away from the commodity complex by the use of end branding, increased advertising activities, improved dealer relations, and the employment of a marketing researcher. The other firms did not seem to be interested in developing a different sales approach.

Advertising and promotional activities

As discussed in Chapter II, lumber firms in the United States are very conservative in their advertising expenditures. Almost all of the advertising for lumber is done by the trade associations rather than by individual firms. Only a few of the very large firms, such as Weyerhauser, Boise-Cascade, and Georgia-Pacific, carry on extensive advertising campaigns. Even with these companies most of the advertising is institutional or technical in content; very little product advertising as such is done. This is another example of the commodity attitude toward lumber held by most lumbermen.

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[9]Stuart U. Rich, "Increasing the Effectiveness of Your Marketing Effort," (Speech delivered at the Annual Meeting of the Western Wood Products Association, San Francisco, March 3, 1965), pp. 12-13. (Mimeographed)

There is little to report about advertising and promotional activities in Arizona as most of the firms did not engage in these programs during the period covered by the study. There was some advertising by the larger firms in newspapers and trade publications, mostly of an institutional nature emphasizing trade names and symbols, quality, and service. No information was available concerning the amount expended by the firms on advertising.

In recent years, many of the larger firms in the nation have been using end-branding or edge-branding of their lumber as a promotional effort. The large mills in Arizona have been end-branding their lumber, especially the better grades. As the branding equipment is costly (approximately $25,000.00), Arizona's small firms had not utilized branding. None of the Arizona firms using branding thought that it had really differentiated their product but that it did help identify the firm in the minds of the buyers and the users of the lumber.

The lack of a significant advertising and promotional effort by the Arizona firms is closely related to and a part of the commodity sales approach discussed above. Economic theory indicates that when a firm is a part of a competitive industry with each firm's demand curve horizontal, there is little need for promotional efforts by individual firms. Lumber executives have practiced this economic theory throughout the history of the industry in

the United States. What the industry has overlooked in recent years is that substitutability of other items for lumber has lessened the inelasticity of the industry's demand curve.[10]

Only in recent years has the industry increased its efforts (through its various trade associations) to actively promote the use of wood products through consumer advertising, trade advertising, and the publication of technical information for architects, builders, and engineers. However, a serious division of loyalties exist in the trade associations: generally, they represent firms in the forest products industry, not just the lumber industry. Many of their members are diversified companies producing other forest products in addition to lumber. The associations, therefore, cannot emphasize the use of lumber to the detriment of other wood products such as plywood, particleboard, and paperboard. Their promotional efforts have to be in the direction of encouraging the use of wood products versus competing non-wood products. Because of this, lumber producers have not had a strong promotional effort to assist them in competing against plywood, their most serious threat.

It is indicative of the commodity complex to note that of the 20 lumber firms in Arizona, only 8 had mem-

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[10]Mead, op. cit., p. 50.

bership in the Western Wood Products Association, the principal trade association in the West. Although this is a higher percentage than the national average, as indicated in Chapter II, it is an indicator of the attitude toward lumber marketing exhibited by the majority of the Arizona lumber producers. Most of the firms are small; their primary interest is in producing lumber with the hope that it will be bought at a price high enough to provide a profit for the year's operations. That many of the small mills have not succeeded in this course is indicated by the reduction in the number of mills in Arizona from 66 in 1946 to 25 in 1965.

Coordination of production with sales

Forecasting.--All of the larger mills made forecasts of the demand for lumber for 30 days ahead and, to a lesser extent, up to 60 or 90 days. The attempt was made to forecast the probable demand for each type of lumber produced by the mill so that production could be adjusted, within the limits discussed below, to meet the demand situation for each product. No formal forecasting techniques were used; it was a "seat-of-the-pants" operation as one manager put it. Good market intelligence and experience in interpreting it appeared to be the vital ingredients in the forecasting procedure. However, many forces were at work to cause the forecaster despair.

Three important causes of uncertainty about the future trend of the market were the weather, labor problems, and the raw material supply. Inclement weather can cause logging operations to stop so that logs are not available to the mill. As pine logs cannot be stored for long periods without the risk of serious deterioration of the wood quality, stockpiling of the raw material is limited. The industry also has labor problems similar in nature to other industries; mills were closed by strikes at various times during the study period.

As discussed in Chapter II, a serious problem for Arizona firms in the supply of saw logs is related to the public ownership of the resource. During the study period, several firms had the problem of an inadequate timber supply. There may be several reasons for a shortage of saw logs at any given time. The good timber in an area being logged may be about exhausted or the allowable cut may have been reached. Firms attempted to forestall this problem by purchasing sufficient quantities of standing timber (usually called stumpage) to provide a continuing source of material. However, this was not always possible as new timber stands opened for logging by the Forest Service or one of the Indian tribes were not always in areas that kept logging and transportation costs within reasonable limits for some firms. Stumpage was sold at auction by the Forest Service to the highest qualified

bidder or bidders and financially weak firms were not always able to bid successfully for the timber. The lack of an adequate long-range timber supply was the principal cause for several mills becoming inactive during the study period.

Other forces that have an affect upon the industry include the fluctuations in the construction industry and government purchases. With about 75 per cent of all lumber being consumed by the construction industry, it is obvious that changes in building activity affect lumber sales. As lumber is an item that needs special storage facilities if it is to be stored for long periods, extensive stockpiling is not possible. Changes in construction activity are felt rather quickly by the lumber industry.

Government purchasing varies from time to time and is difficult to forecast. Direct government purchasing during the period covered by the study was not large. However, the Vietnam war has caused a sharp increase in government lumber procurement and there was a serious problem in 1966 due to increased buying by the federal government and an acute shortage of rail cars.

The mills attempted to forecast these variables so that they could plan production levels for the various types of lumber. One firm recently added a marketing researcher to its staff to assist it in forecasting demand. In other firms, the sales managers were usually responsible

for forecasting activities.

Lumber production.--As indicated in Chapter II, the type of lumber produced is primarily a production decision made by non-management employees based upon very brief visual inspections of a log and the pieces cut from it as they pass through the production process. Although there is some latitude, the quality of the log and the skill of the operators are the determining factors as to what products are cut from the log.

Decisions by 3 operators in the production process determine the types and grades of lumber that are produced from a log. At the headrig, decisions on thickness are made by the head sawyer. At the edger, the edgerman determines widths for each piece. The trimmerman trims the pieces to optimum lengths. These 3 operators, acting independently, are responsible for the final grades and types of lumber produced. No management level personnel have been involved in the decision making. The quality and type of product produced from a given log is dependent upon the experience, judgment, and motivation of these workers.

Adjustment of production.--In addition to the problems inherent in the production process, there are other factors that make it difficult to adjust production to market requirements. Dimension is graded on the basis of structural strength and boards on the basis of appear-

ance, making it nearly impossible to produce only one and none of the other without prior segregation of the logs. If all logs available to the mill are used, the proportion of each type of lumber that is produced will be primarily dependent upon the quality of the logs. Some latitude is possible as some logs or log portions are capable of being cut into either product. Grade quality may decline, however, when shifts between the 2 products are made. In other words, high grade dimension cut to make boards may produce a lower grade board and, conversely, logs that would make high grade boards may produce lower grades of dimension. Production personnel attempted to obtain the highest recovery possible from the material available to them.

One method that most of the mills utilized to help control the types of products available for sale was the production of 6/4 by 8 lumber. Prior to surfacing, the decision could be made to sell the Standard and Better grade (a dimension grade) as 2 by 8's, to profile it (cut) into two 2 by 4's, most of which will still be of Standard and Better grade, or to re-saw it into two 1 by 8's, the majority of which will be of No. 3 Common grade.

There was a good, though sporadic, market in Southern California for 6/4 x 8 resawn No. 3 Common patterned for paneling. The price for this product could and did increase as much as $10.00 per 1,000 board feet when

the demand for the item was heavy. With a supply of 6/4 by 8 on hand, a mill could move quickly into this market. If the demand for 6/4 resawn was not strong, it was sold either as 2 by 4 or 2 by 8 Standard and Better, depending upon the market. This procedure was especially valuable for mills without kilns as they had a long delay between the time the log was originally sawed and the time it was dry and ready for sale.

As indicated in Tables 8 and 9, Appendix C, by 1965 the price of dimension had recovered to pre-1959 levels while the prices for boards were still 15 to 25 per cent below their previous levels. With this strong demand for dimension, the mills were attempting to produce a higher proportion of 2 by 4's and 2 by 6's and to reduce their output of boards. The use of 6/4 lumber aided in this adjustment and permitted them to remain flexible enough to meet rapid changes in the market.

Most of the Arizona mills attempted to make adjustments, within the limitations discussed above, in their product mix to better adapt to market conditions. For example, in one Arizona firm that made a very serious effort to coordinate sales needs with production, the sales manager advised the production manager weekly as to the types and kinds of lumber that would be needed. The production manager, in turn, informed the equipment operators in writing as to what types of lumber they should

be attempting to recover. Of course, the log itself was the critical dimension in this type of situation as explained above. However, the mill cut what was needed to the best of its ability from the logs available.

Vertical integration

The degree of vertical integration among Arizona firms, especially beyond the processing stages, was extremely limited. With a few exceptions, most of the mills produced lumber and offered it for sale to wholesalers, retailers, industrial firms, and remanufacturers. This was the extent of their activity. Two or 3 of the firms (the number changed from time to time during the study period) operated distribution yards in selected metropolitan areas to serve as wholesale centers for the retail yards in the area. These distribution yards accounted for only a small fraction of all the lumber marketed during the survey period (see Tables 16 and 17, Appendix D). In addition, these same firms operated local retail yards in a few locations in Arizona. The names of these yards were different from the names of the parent companies; a casual observer was not aware of any connection between the retail yards and the sawmills.

Although the limited vertical integration followed by the Arizona producers is common in the industry in general, not all lumber producers in the nation refrain

from engaging in large scale wholesaling and retailing activities. For example, Boise-Cascade operates numerous retail lumber yards, as do many other producers in the Northwest, and the Weyerhaeuser Company operates 75 distribution centers located in all the major markets in the country. Weyerhaeuser's annual statement for 1965 indicates that 10 of these centers are new and that many of the others have recently been expanded and enlarged.[11] Georgia-Pacific operates "company-owned wholesale distribution centers in 95 key markets across the country."[12]

Merchant middlemen and legal title

Lumber firm executives were not concerned with the distinction between a merchant middleman and an agent middleman. In other words, they were not interested in whether or not the intermediate buyer took legal title to a shipment of lumber going directly to a final buyer. There was a distinct difference of opinion among the persons interviewed concerning this point: one executive stated that intermediate buyers took title and another was positive that they did not.

The question was asked to satisfy more than academic curiosity; the researcher was concerned about how

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[11] Annual Report, 1965, Weyerhaeuser Company (Tacoma, Washington), p. 13.

[12] Georgia-Pacific Corporation, advertisement, Time, May 12, 1967, p. 91.

questions involving disputes over the quality and the quantity of lumber shipments were resolved and who was responsible for damages to or losses of the product during shipment. Quality and quantity disputes, regardless of whether the lumber was sold through an intermediate buyer, were referred to the appropriate trade association for investigation. Apparently, all parties concerned usually accepted the decision of the trade association inspector.

Damages or losses occurring while a lumber shipment was in transit on a common carrier were the responsibility of the carrier. Either the buyer or the seller or, on occasion both, would work with the carrier in arriving at a satisfactory settlement. This did not appear to be a problem of much consequence.

New product development

Nationally, the lumber manufacturing industry ranks at the bottom of 15 major manufacturing industries in the percentage of net sales spent on research and development activities.[13] It also ranked last in the number of scientists and engineers employed in relation to the total number of employees.[14] It is not known what part of the research activity that was conducted involved

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[13]Joseph Zaremba, Economics of the American Lumber Industry (New York: Robert Speller & Sons, 1963), pp. 203-4.

[14]Mead, op. cit., p. 239.

new or redesigned primary products; apparently it would be a small proportion as there is evidence that most of the research has been directed toward the increase of productivity in the mill.[15] That little new product research has been done is also evidenced by the fact that there have been no successful new lumber products placed on the market. In the broader concept of the forest products industry, there have been several very successful new products developed and marketed such as plywood, particleboard, hardboard, and paperboard. The irony of this situation is that these products compete directly with lumber in many applications.

The new product development situation in Arizona was typical of the national pattern in that there was little effort made by most of the firms to investigate possible new lumber products. Southwest Forest Industries did produce and market a new lumber product (Pronto Panel) at the beginning of the present decade. This item was designed to utilize low grade lumber and to compete directly with plywood in roof decking and sub-flooring applications. It consisted of random pieces of low grade boards bound together into a continuous sheet 8 feet wide by glueing heavy craft paper on each side of the lumber. The continuous sheet was cut every 4 feet to provide 4 by

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[15] Ibid.

8 foot panels.

Pronto Panel apparently did not prove successful as it is no longer being produced. Two reasons were given for its demise: first, there were problems involved in obtaining trade acceptance of the product. Secondly, a more profitable utilization of the low grade lumber was provided by the establishment of the new pulp mill at Snowflake.

Other product innovations have been limited to the preservative treatment of lumber to make it more moisture resistant and the waxing of the ends of lumber to help prevent checking. No other significant product developments applicable to lumber were discovered.

Southwest Forest Industries has been experimenting with the production of plywood from ponderosa pine and the company has announced that it plans to construct a plant in the near future. The potential for this product and other wood products is discussed in the following chapter.

Lumber measurements.--Related to the development of new products better adapted to end uses is the problem created by the multitude of so-called "standard" sizes of lumber. The entire industry uses standard--and many non-standard--sizes that cause confusion for consumers of lumber. In addition, the common names for lumber items are not indicative of the actual measurements of the items. Appendix E presents a table of standard lumber sizes as

published by the Western Wood Products Association. Although these are the accepted standard sizes, additional sizes were used by Arizona producers and the prices of these non-standard items were quoted in such publications as Crows.

To indicate the confusion these sizes can present to a person not intimately involved in the lumber industry, the following examples are presented. A board sold as a 1 by 12 is not 1 inch thick by 12 inches wide but 25/32 inches thick by 11-1/2 inches wide. A person wishing to use 1 by 12's as sheathing would find that eight 1 by 12 boards would not cover horizontally a normal wall 8 feet high; an additional 6 inches would be needed to fill the full 8 foot height of the wall. The standard measurements for a 2 by 4, the primary dimension item, are not 2 inches by 4 inches but 1-5/8 inches by 3-5/8 inches. To add to the confusion, 2 by 4's were also sold in 2 other thicknesses: 1-1/2 inches and 1-9/16 inches.

In contrast to lumber producers, plywood and particleboard producers have adopted exact measurements for their products: a 4 by 8 foot sheet of plywood, for example, is 4 by 8 feet in actual measurements. This means for standard construction purposes, 2 panels placed lengthwise on the structural frame of a building would fill an 8 foot high by 8 foot wide wall section.

There is a move to establish new measurement

standards for lumber. Under the proposed standards, a 2 by 4, for example, would have a finished thickness of 1-1/2 inches compared to the present standard of 1-5/8 inches. However, at this writing the new standards have not been adopted by the Department of Commerce. A recent survey by the Department revealed that about 75 per cent of the distributors polled favored adoption of the new standards but that about 45 per cent of the producers opposed adoption.[16] Due to the opposition by producers, the new standards will not be put into effect at this time.

Summary

This chapter has presented the results of the investigation into the marketing practices of the Arizona lumber industry. Emphasis was placed on the fact that the Arizona firms followed the industry-wide practice of considering lumber as a commodity and that their sales efforts were based on the offering of a commodity for sale. A product marketing approach was presented as an alternative to the commodity approach. Involved in the product approach is the development of products designed for end-users and marketed as differentiated products or integral systems. The following chapter contains a review of new,

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[16] Crows Weekly Letter (Portland, Oregon: C. C. Crow Publications, Inc.) April 28, 1967, p. 1.

market-oriented products that could be produced in Arizona from the currently available timber.

CHAPTER VI

POTENTIAL NEW PRODUCTS FROM ARIZONA TIMBER

The lumber industry in the United States has been very reluctant to adopt or develop new products. Most of the lumber items being produced today are the same lumber products that the industry has produced since the nineteenth century. As discussed in previous chapters, research and development expenditures by the industry are very low in comparison to other major industries. Even within the broader forest products industry, expenditures for lumber research and development rank a poor third behind the pulp and paper industry and the veneer and plywood industry. One estimate indicates that recent research and development expenditures per 1000 cubic feet of wood used were $17.10 for the pulp and paper industry, $5.75 for the veneer and plywood industry, and $1.50 for the lumber industry.[1] There is no information as to the proportion of this meager sum that was used for new product research and development; presumably the major portion of the expenditure was for improved technology.[2]

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[1] Walter J. Mead, Competition and Oligopsony in the Douglas Fir Lumber Industry (Berkeley: University of California Press, 1966), pp. 239-40.

[2] Ibid.

Many explanations for the lack of interest by the industry in new lumber products have been proposed. Zaremba argues that the competitiveness of the industry provides an innovator only a very temporary advantage in the introduction of a new product.[3] In his opinion, information is disseminated quickly throughout the industry and an individual firm, with only an infinitesimal share of the market, cannot capitalize on an innovation. In this report, the lumber industry is comparable to agriculture in that an individual farmer does almost no research on his own, depending upon public agencies and major industry suppliers for technological progress.

With the exception of a handful of large firms, it is probable that the lumber industry will continue to depend upon the government and universities for new product research and development.[4] It is possible that trade associations might devote more effort to the development of new lumber products. It is the writer's opinion, however, that as long as most of the trade associations represent all phases of the forest products industry, their efforts in new lumber product development will be minimal. It is probable that most new, market-oriented lumber prod-

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[3] Joseph Zaremba, Economics of the American Lumber Industry (New York: Robert Speller and Sons, 1963), p. 196.

[4] Ibid.

ucts will come into being through the efforts of secondary manufacturers and the major end-users of lumber such as the residential construction industry.

It appears that the entire lumber industry is afflicted with the commodity complex and has made little attempt to design new products for new and different end uses. However, there are many indications that this is what is needed to assist the lumber industry in maintaining pace with the economy.

In a penetrating article in Land Economics, Walter J. Mead gives a positive proposal to strengthen the lumber industry. He states ". . . corrective measures should concentrate on (1) efforts to increase efficiency, (2) expanded research in new product development, and (3) the introduction of more effective marketing techniques."[5] Many other references from experts in the industry concerning the need for the development of new products could be cited. The preceding chapters and references give a good indication that new product development is essential to the lumber industry if it is to compete successfully with substitute wood and non-wood materials.

Projections by the Forest Service indicate that there will be an increased demand for wood and wood prod-

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[5]Walter J. Mead, "A Positive Proposal to Strengthen the Lumber Industry," Land Economics (May, 1964), p. 145.

ucts in the next 3 decades.[6] Perhaps there is no urgency felt by the industry in view of the commonly accepted belief that the demand for lumber will continue to increase. Students of the industry, however, have repeatedly indicated that better engineered, better designed, more customer-oriented materials are needed to retard or stop the substitution of other materials for lumber and wood products.

In the last decade there have been numerous research bulletins, technical reports, and trade articles about new wood products that have been either developed or have reached, on a very restricted scale, the production state. This chapter is a brief examination of some of these new lumber and wood products that have been presented in the industry's technical and trade literature; potentially, all of them could be produced in Arizona from ponderosa pine. The approach is selective rather than exhaustive and it is intended only to be indicative of the types of products that the Arizona industry should investigate. As a thorough discussion of the economics of potential new products would be a complete study in itself, the purpose of this chapter is to point out that new products have been developed that provide a better utilization of

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[6] U. S. Forest Service, Timber Trends in the United States, Forest Resource Report No. 17 (Washington: U. S. Government Printing Office, 1965), pp. 61-68.

the raw material and, even more important, are market-oriented.

The presentation is divided into 2 sections. The first section will examine possible new lumber products and the second section will examine other new primary wood products that would be either complementary to or in replacement of lumber production.

Possible new lumber products

In the preceding chapter there was much discussion concerning the commodity complex held by most lumber firms. By this the author intends to imply that the lumber producers are somewhat in the same position as the wheat farmer, at least as he was prior to the imposition of government production controls. The farmer grew as much wheat as he could and then offered it on the market when and where he felt he could get the best price. Advertising, promotion, and new product development were not part of his *modus operandi*.

The lumber industry exhibits this type of commodity complex. They are "too busy" producing lumber and placing it on the market to be concerned with other possible products. At least this is the opinion one gathers about the great majority of the firms in the industry from reading the literature of the field and investigating the operations of firms. There are obvious exceptions to this

generalization and the intensity of this complex varies in degree from firm to firm. All the firms investigated in this study were subject to some degree of this attitude, many of them to an alarming degree.

If the history of the lumber industry is an indicator of its future, many of these firms with the commodity complex will not survive due to the inability to adapt to changing market conditions. Although this discussion concerns the Arizona industry, much of what is said pertains to the lumber industry in general and is not restricted to the Arizona industry.

It has been proposed in many articles that lumber manufacturers should turn from the commodity attitude to the product or systems concept of marketing. This means that the firm would produce a product designed for a specific end use; it would have to guarantee the product to perform as stated in the specifications. A systems approach would be the development of a total package of lumber products that would be utilized by an end user to achieve a given purpose. For example, it has been proposed that pre-cut and pre-assembled partitions and wall panels be made available to builders so that they need only to put the panel in place during construction. Much research has been done, primarily by the Forest Products Laboratory, to develop a system of this type. Limited applications of this concept have been made.

The research specialists and engineers at the Forest Products Laboratory have designed a new house-building system consisting of 6 component parts that comprise the walls, the partitions, and the roof.[7] The system uses standard 2 by 4's, boards, plywood, and other common building materials. Each of the components is assembled at the factory and the parts are united at the construction site by the builder. Flexibility in the design of the house is provided as each component is made in standard size modules. It is claimed that this system offers the following advantages: (1) The savings inherent in factory-made components. (2) Rapid assembly at the building site, with further cost savings. (3) Built-in soundproofing as an integral structural feature. (4) Lifetime plastic-covered roof. (5) Unique roof trusses assuring economy, structural rigidity, and flexible use of space. (6) Advanced engineering that permits extensive use of relatively low-cost plentiful grades of lumber.

This system could be produced by lumber manufacturers at present sawmill sites or by independent manufacturers purchasing the lumber and the other materials from the appropriate suppliers. It appears that this system offers one possible solution to the Arizona lumber

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[7]U. S. Forest Service, Development of an Improved System of Wood-Frame House Construction, U. S. Forest Service Research Paper FPL-47 (Washington: U. S. Government Printing Office, 1966).

industry for a better utilization of low-quality lumber. This researcher was unable to discover any evidence that this has been attempted in Arizona or even given serious consideration.

Of course, many problems are involved in introducing a radical new system such as this. One of the serious problems that probably would be encountered would be opposition by the construction unions. Historically, they have opposed most innovations in construction techniques. However, Arizona might be a good state in which to introduce the system as the state has a so-called "right-to-work law;" labor should not be a barrier to this type of construction in Arizona if a major builder were to adopt this system.

Another system of much simpler design has been developed by a firm in Fort Worth, Texas.[8] This design consists of prefabricated wall panels made with standard lumber items but without the use of nails. Tight-fitting joints (such as dovetail joints) are cut in the wood at the factory and wall panels, trusses, and other standard building sections are assembled at the mill. It is claimed that this technique increases resistance to wall cracking and popped nails as the fitted joints almost eliminate twisting or warping of the wood.

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[8] Mal Hernandez, "Framing Without Nails," The Arizona Republic (Phoenix), February 20, 1966, p. 2-E.

Precision Components has been franchised by the Key Kut Company to produce these prefabricated panels in Arizona and operations started in Phoenix in 1966. In addition to manufacturing the product, Precision Components has a subsidiary construction company for the installation of the components at the building site. At this time it is too early to determine the success of this company or its probable future. It does represent a new and different approach to the use of lumber items.

Weyerhaeuser provides a good example of what can be done by a progressive company in new product development. This company, with annual sales of over $800,000,000.00, is the third largest forest products firm in the United States.[9] It may be unfair to use a giant such as this as an example, but its leading status may be the result of its approach to lumber marketing. The Weyerhaeuser Company has made a great effort to escape the commodity approach to lumber marketing. A recent article about the company states:

> To escape the commodity stigma, Weyerhaeuser has established about 35 trademarks, ranging from its 4-Square lumber products (mainly boards cut to specific functional sizes required by end users) to Presto-logs (compressed sawdust fireplace logs). George Weyerhaeuser says that the company's research and development centers are pursuing at least 100 more products that will be distinctly

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[9] Crow's Weekly Letter (Portland, Oregon: C. C. Crow Publications, Inc.), March 31, 1967.

Weyerhaeuser.[10]

Laminated wood beams have come into wide usage in recent years. They are not only a good structural material but they have been used for esthetic purposes in many types of commercial and industrial installations. Barger and Fleischer indicate that low-grade lumber can be used to produce construction beams with the proper laminating operation.[11] They suggest that the minimum size for a laminating plant would be one that could process approximately 5,000 board feet of material per 8-hour shift. The estimated cost for the equipment necessary to produce laminated beams at this rate is less than $30,000.00. It is surprising that no firm has entered into laminated beam production in Arizona in view of the low investment required and the apparent increase in the demand for such items.

Many additional examples of possible approaches to the product or systems concept of lumber marketing as a replacement for the commodity concept could be cited. However, the ones given above will suffice to indicate that there are new products and new ideas for product

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[10]Steve Blickstein, "The Weyerhaeuser Way: It all Starts with the Log," Sales Management, The Magazine of Marketing (December 17, 1965), p. 26.

[11]Roland L. Barger and Herbert O. Fleischer, New Products from Low-Grade Ponderosa Pine Timber, U. S. Forest Service Research Paper RM-10 (December, 1964), p. 22.

development available to the industry at the present time.

By-products from mill residue.--The utilization of mill residue for the production of marketable products has not been exploited by Arizona producers. The establishment of the pulp mill at Snowflake has provided an outlet for some of the waste materials from lumber production in Arizona. However, there is still much mill residue being disposed of by burning. As this writer traveled around the state visiting sawmill locations, waste burners were observed in operation at most mills. Some mills burn the mill residue to produce steam for kilns or to generate electricity for the operation of the mills. However, very few mills in Arizona are now producing their own electricity as it usually is less expensive to buy electricity than to maintain a generating system. It is not known what proportion of mill residue is burned in Arizona at the present time.

In addition to paper production, mill residue can be utilized in the manufacture of other very marketable products. For example, various types of particleboard can be made from wood chips.

> Hardboard and particleboard are made from leftovers resulting from the manufacture of lumber or plywood and from small diameter logs. Strength, attractive appearance, utility, durability, a high strength-to-weight ratio and other desirable properties of wood are maintained or enhanced in these panels. The wood is refined and converted in form

but wood or wood fibers remain the basic ingredients.[12]

There is a good market for particleboard as its dimensional stability and durability make it an ideal base in plastic laminated furniture and counters and as an underlayment in flooring. Tests have proved that ponderosa pine is suitable for the production of such a product;

> Exploratory tests at the Forest Products Laboratory have shown that ponderosa pine is well suited to particle-board manufacture. Specific products that should warrant consideration include flake-type furniture-core particle board, a furniture core or underlayment board made from standard planer shavings, and a newly developed thick board made from pulp-type chips in combination with standard flakes.[13]

Barger and Fleischer estimate that an investment of about $1,000,000.00 in equipment is needed to operate an optimum sized particleboard plant. As this is not an excessive investment, it is surprising that no particleboard plant is in operation in Arizona. Admittedly, the new pulp mill has reduced the need for this type of outlet for mill residue; however, it is the opinion of this writer that mill residue is available in sufficient quantity in the state to support a particleboard operation. Such a plant would also provide an additional outlet for low-quality lumber, the perennial problem for Arizona producers.

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[12] Progress in Private Forestry in the United States (Washington: American Forest Products Industries, Inc., 1961), p. 16.

[13] Barger and Fleischer, op. cit., p. 15.

Other primary wood products

In addition to the possibility of producing other lumber products, the industry in Arizona could diversify into the production of other primary products from wood. Southwest Forest Industries has been the first firm in the state to diversify into another primary wood product with the establishment of the pulp and paper mill at Snowflake. This company has also announced that they are considering the establishment in the near future of a plywood mill in Arizona.

Plywood production offers an important alternative to lumber production for Arizona firms. In a very thorough experiment by Barger and Fleischer at the Forest Products Laboratory, it was determined that it is technically feasible and economically possible to produce 4 x 4 foot panels of plywood from Arizona ponderosa pine.[14] The principal use of this product would be in construction as underlayment in floors and as sheathing. This would provide a product that is desirable to the construction industry due to its lower in-place cost. It would also provide a good utilization of the low-quality timber found in Arizona.

Southwest Forest Industries shipped pine saw logs to a plywood mill in Oregon to determine the feasibility

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[14] Ibid., pp. 4-15.

of the mass production of plywood from ponderosa pine. According to its annual statement, the experiments indicate that it is feasible to mass produce ponderosa pine veneer and plywood in Arizona.[15] A veneer and plywood operation in Arizona would provide an attractive alternative to the production of low-grade commons. Barger and Fleischer estimate that the equipment necessary to produce 4 by 4 foot panels of pine plywood would cost from $450,000.00 to $600,000.00, not a prohibitive amount.

In the section above, it was suggested that mill residue could be used to produce particleboard. Particleboard production also could be a primary industry itself, purchasing timber on the stump as well as utilizing mill residues. As the investment required to establish a particleboard plant is not prohibitive and as the construction industry provides an excellent market for panel products, it is the writer's opinion that the potential for particleboard production in Arizona needs intensive study.

Pulp and paper production is the third major component of the forest products industry. An additional pulp and paper mill in Arizona is probably not feasible at the present time. In addition to Southwest Forest Industry's mill at Snowflake, another plant has been constructed at Flagstaff to produce tissues and toweling.

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[15] Annual Report, 1965, Southwest Forest Industries, Inc. (Phoenix, Arizona), p. 2.

This plant became operational in 1965 but was in operation for only a short period of time when it was closed by a lengthy strike. After the strike, it operated for only a short period and then was closed by management for extensive redesigning. At the time this is being written (April, 1967), the mill is still closed and there has been no public announcement as to an expected re-opening date.

A fully integrated pulp and paper mill, such as Southwest's, requires a very sizeable investment. It is estimated that the mill at Snowflake involved an investment of about $40,000,000.00. It is doubtful that financial backing would be available for a third mill in the state, especially in view of the experience of the new plant at Flagstaff.

Summary

Many other products utilizing wood and lumber could be added to the ones suggested above. These appear to the writer to be the most promising products available to the Arizona industry. Further investigation into the economics of the production of these products and the market potential for each one would be necessary. It is the writer's opinion that the Arizona industry must investigate additional alternative uses for much of its low-grade lumber if the industry is to grow and prosper and if the forest resource is to be utilized in the most efficient

and productive manner possible. The following chapter presents recommendations for the Arizona industry based on the products presented in this chapter.

CHAPTER VII

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this study was to determine what impact the changing patterns in the consumption of lumber have had on the Arizona lumber industry and to examine how the industry was adapting to the changing market situation. Data concerning the changes in the uses of and the demand for lumber products in the United States were gathered from secondary sources and are presented in Chapter II. Information about the Arizona industry was gathered from original documents provided by Arizona lumber producers and from interviews with executives and other industry representatives. This information was of 3 types: (1) product information including types, grades, and quantities of lumber marketed during the period covered by the study; (2) market information consisting of types of buyers and the destinations of lumber shipments; and (3) information concerning the performance of the marketing functions by Arizona lumber firms. The information obtained from this investigation is presented in Chapters IV and V.

This chapter presents a summary of the findings of

the investigation and the writer's conclusions based upon these findings. The chapter concludes with recommendations that the writer hopes may be of some value to the Arizona industry.

Before listing the findings, a review of the conditions under which the study was made is in order. Invoice files dating back many years were not available at many of the firms; the study is, therefore, based on the industry's activities for the years of 1959 through 1965. Product and market data are based on the analysis of a sample of sales invoices selected from the available invoice files. As the files were not complete for all years, probabilistic statistical inference techniques were not applied to the data; however, the size of the sample, the consistency of the data, and the information obtained through the interviews indicate that the variations are real and not due to sampling error.

Summary of Findings

The findings listed below are for the period 1959 through 1965 unless otherwise noted; no further indication will be made of the period involved in the findings. Definitions of technical terms are contained in Appendix A.

1. As one of the nation's basic industries, the lumber industry is an important contributor to the national economy. In 1958, timber-based economic activities had a

value added of 25 billion dollars, 5.6 per cent of the gross national product, and employed 3.3 million persons. In the last 20 years, however, lumber has been subjected to increasing competition from substitute materials, primarily panel products such as plywood and particleboard. Panel products, due to their more useable and uniform sizes, provide builders with savings in labor costs. The quantity of lumber used per unit of construction has been steadily declining as a result of the use of substitute materials and new construction techniques.

2. Lumbering is an important industry in the manufacturing sector of Arizona's economy, ranking eighth in total value added by manufacturing and sixth in the number of manufacturing employees in 1963. Annual lumber output ranged from a low of 326,000,000 board feet in 1961 and 1962 to a high of 411,000,000 in 1964. The number of active mills declined from 66 in 1946 to 38 in 1960 and to 25 in 1965.

3. Ponderosa pine accounted for 82 to 89 per cent of all the lumber marketed with Douglas-fir, white fir, and small quantities of spruce comprising the remainder.

4. The lumber sold by Arizona firms was predominantly in the lower common grades. Commons (both boards and dimension) accounted for 72 to 78 per cent of all lumber sold. This high proportion of commons was due to the low quality of the saw logs available in Arizona.

5. Fifty-seven per cent of all the lumber sold in 1959 and 1961 was in the board classification. This proportion dropped to 51 per cent in 1963 and to 44 per cent in 1965. No. 3 Common and poorer grades accounted for 87 to 90 per cent of all the boards sold.

6. In 1962, a pulp and paper mill was placed in operation in Arizona providing an alternative to the production of No. 5 Common. By 1965, 11 of the larger sawmills had installed chipping equipment to convert low grade wood and bulk mill residue into chips for sale to the pulp mill and the production of No. 5 Common boards was greatly reduced.

7. The proportion of dimension lumber marketed increased from 14 per cent of total sales in 1959 to 28 per cent in 1965. Dimension was concentrated in the lowest 3 grades and in the 2 by 4 and 2 by 6 sizes. A definite effort was made to produce more dimension and less boards.

8. Eighteen to 23 per cent of all lumber sold was resawn. Resawn lumber was predominantly in the 6/4 classification and was concentrated in the lower 3 common grades.

9. The proportion of shop lumber marketed varied from 16 to 23 per cent of total production. The percentage of shop that can be produced is totally dependent upon the quality of the raw material.

10. The select grades of lumber accounted for 5 to

7 per cent of all lumber marketed. As with shop, the proportion of selects was controlled by the quality of the saw logs available to the mill.

11. The principal market area for Arizona lumber was the Southern Rocky Mountain region. The proportion of lumber shipped to this area varied from 39 to 47 per cent of all lumber produced. The Central States region was second in importance and the West Gulf region was third. The proportion shipped to the Central States region declined from 27 per cent of all lumber sold in 1959 to 19 per cent in 1965. The reverse was true for the West Gulf region: the proportion that went to this region increased from 10 per cent in 1959 to 18 per cent in 1965.

12. The proportion of lumber shipped to Arizona destinations varied from 22 to 30 per cent of all lumber sold. The composition of the types of lumber retained in the state was different from the product mix exported from the state. As compared to the lumber exported from the state, the retained lumber was composed of a much higher percentage of dimension and a much lower percentage of boards; exported lumber contained a slightly smaller percentage of shop lumber.

13. The relative importance of the types of firms that received shipments directly from the mills changed during the study period. The proportion of lumber received

by final buyers in 1959 was 44 per cent for retail lumber yards, 34 per cent for wood products manufacturers, 14 per cent for lumber wholesalers, and 8 per cent for other types of buyers. In 1965, these proportions were 39 per cent for retail yards, 25 per cent for manufacturers, 20 per cent for wholesalers, and 16 per cent for other types of buyers.

14. The proportion of shipments going by rail declined from 50 per cent in 1959 to 43 per cent in 1965. Truck shipments were limited to about 800 miles from the mill site and rail was used for shipments in excess of that distance.

15. Lumber was sold on a delivered basis. When a common carrier was used, the buyer made direct payment of the freight costs to the transportation company, deducting the amount of the freight from the invoice amount. The cost of transportation was high in relation to the value of the product. Freight costs for rail shipments east of the Mississippi River were as much as 100 per cent of the product cost in the lowest grades; in the middle grades, freight amounted to 40 to 50 per cent of the value of the product.

16. The lumber industry is a competitive industry with prices for the various lumber items determined by the demand for and the supply of the different products. The prices for boards dropped sharply in 1960 and remained

15 to 25 per cent below the average prices for the 1957-1959 period. Shop and dimension prices also dropped in 1960 but recovered so that they were above the 1957-1959 average by 1965.

17. The sales effort was essentially devoted to the notification of potential customers of products available for sale. Customer contacts were made primarily by telephone and by mail. There were some direct mill salesmen located in various metropolitan centers outside of the state; however, several of the smaller firms did not maintain salesmen, relying upon a sales manager or general manager for the performance of the selling activities. One firm used a sales agent instead of maintaining its own sales department. The approach to the sales effort was based upon the concept that lumber is a commodity--an undifferentiated product--and that price and availability were, therefore, the important factors in a sales transaction.

18. Advertising and promotional activities were minimal; the industry relied primarily upon the trade associations for the major effort in this area. However, only 8 of the 20 firms were members of the principal association in 1965.

19. The larger firms made forecasts of potential demand for the various lumber items and adjusted production within the limits permitted by the raw material and

the production process, so that sufficient quantities of the items in demand would be available. The mills used the production of 6/4 lumber to assist in the coordination of production with demand. Depending upon the market, 6/4 by 8 lumber could be sold as 2 by 4 or 2 by 8 dimension or resawn and sold as boards. The percentage of resawn lumber sold (see No. 8 above) was a significant proportion of total sales.

20. There was little vertical integration beyond the processing stages among the firms. A few firms operated wholesale distribution centers and retail lumber yards but these outlets accounted for only a small portion of all the lumber marketed.

21. One new product, Pronto Panel, was introduced and discontinued after 3 years of production. No other new lumber products were marketed.

Conclusions

The hypothesis for this study was that the markets for Arizona produced lumber were changing but that the Arizona lumber industry was not adapting to these changes. Based on the findings presented above, it is concluded that the markets were changing during the study period. These changes are indicated by the decrease in the proportion of boards and the increase in the proportion of dimension in the product mix, the change in the types of

firms that bought Arizona lumber, the decrease in the quantity of No. 5 Common sold, and the changes in the relative importance of the regions to which Arizona lumber was shipped.

The most important change, and a significant contribution to the stability of the industry in Arizona, was the alternative market provided for low grade wood by the construction of the pulp and paper mill by Southwest Forest Industries. At the start of this decade, the Arizona lumber industry was in a precarious position. Lumber prices dropped sharply in 1960 and Arizona sawmills, dependent upon a raw material of poor quality, were in the position of having to produce a high proportion of the very low priced common grades of lumber. No. 5 Common lumber posed one of the most serious problems for the industry. The price for this grade was so low that it was unprofitable to produce and the cost of transportation to most market areas was so great that it was equal to the value of the lumber. Yet a relatively large proportion of the grade had to be produced because of the quality of the raw material.

The pulp and paper plant built by Southwest Forest Industries provided the sawmills, for the first time, an attractive alternative to the production of No. 5 Common. Although the investment was sizeable, 11 of the larger mills had installed the necessary equipment to make chips

for sales to the pulp mill by 1965. As soon as these mills started producing chips, they stopped production of No. 5 Common. It is the writer's opinion that the construction of the pulp mill was a major contribution to the Arizona industry.

The second part of the hypothesis was that the Arizona firms were not adapting to the changing markets for lumber. It has just been indicated that one major adaptation did take place. Although only 8 of the 20 firms had installed chipping equipment by 1965, the 11 sawmills operated by these firms represented a major proportion of the production volume in the state.

Another adjustment made by the industry was the increased production of dimension and the decreased production of boards. Prices for boards remained depressed throughout the study period but, by 1965, dimension prices had recovered to their pre-1960 levels. Within the limitations imposed by the quality of the raw material and the production process, the mills attempted to adjust to demand by increasing the proportion of dimension in their product mix. The use of 6/4 lumber that could be sold as either dimension or boards gave the mills a desirable degree of flexibility.

These adjustments indicate that the industry was adjusting its output to take advantage of new market opportunities. However, with one exception, the writer

found no evidence to indicate that the industry had made or was planning to make other changes in its product mix. With boards meeting increasing competition from panel products, the Arizona lumber industry remained in an unfavorable position in 1965 as boards still accounted for 44 per cent of total output. One firm has announced that it plans to start the production of plywood in the near future; no other indications of new products were discovered during the investigation.

There was one major area in which only slight changes and modifications were made by Arizona firms during the study period: there was no significant change in the performance of the marketing functions. Most of the firms viewed lumber as a commodity, a concept held by a great majority of the lumber producers in the country. Under a complete commodity concept, the dissemination of information about products available for sale and their prices is the major marketing effort. Advertising and promotional activities are not engaged in by individual firms; these functions are relegated to the trade associations. With the commodity view, there is no reason to determine the needs of the end-users of the commodity or to develop products designed for specific applications. No effort need be made to differentiate the products of one producer from those of another. No attempt is needed to market products and systems rather than commodities.

The degree to which the Arizona firms followed a commodity marketing approach varied from firm to firm. Some firms were almost completely commodity oriented; other firms were only moderately committed to a commodity approach. A few of the firms were beginning to move toward a product selling approach, though the changes were minor during the study period. It is the writer's opinion that the large firms, because of the pressures of competition, will abandon the commodity approach in the coming years; it is doubtful that the smaller firms will have the financial or manpower resources to make the change.

In summary, it must be concluded that the markets for Arizona lumber are changing and that the industry has made significant adaptations to the new conditions. However, additional adjustments are needed in products and marketing procedures to meet the challenge of competition and continuing change.

Recommendations

It is not difficult for an independent observer with no financial interest nor decision-making responsibility to arrive at conclusions and to make suggestions for the improvement of an industry. Based on the above findings, however, the writer believes that there are certain areas in need of investigation by the Arizona lumber industry. It is recognized that the current status

of the industry in Arizona is more the result of the situation of the entire industry in the United States than it is the result of the actions of Arizona entrepreneurs. A great improvement in the status of the Arizona industry would have to be the result of changes in many industry-wide procedures. The following recommendations are limited, therefore, to changes that the Arizona industry can make independently of the national industry.

There are 3 inter-related areas that offer an opportunity for expansion for the Arizona industry. The first area that needs thorough investigation is the development of alternative methods of utilizing the low grade saw logs that make up nearly 80 per cent of all the timber available in Arizona. Chapter VI presented several possibilities for new products and new methods of utilizing the available raw material. Plywood production is suggested as a particularly attractive market-oriented product for Arizona producers.

It is recognized that to develop new products and to get them into distribution is a difficult task; however, to disregard the changing patterns of lumber consumption and the increasing competition from other products by limiting production to existing products could lead to a deterioration of the industry in the state. Aggressive action is needed in this area of new product development if the resource is to be utilized in a way that results in

optimum benefits to the nation and to the Arizona industry.

Closely related to new product development is the need for a product or systems approach to the marketing of lumber. This would require the development of products designed for end-users as well as a change in the attitude toward and the organization of the marketing effort. A new and different type of selling effort would be required to get the products into the channels of distribution and to influence end-users to adopt the products. Suggestions as to how this could be accomplished were offered in Chapter V.

The third area is a change in the promotion program. Two of the larger Arizona firms, recognizing this need, have inaugurated more aggressive promotional programs. Actually, two types of activity are needed. The first is a united effort combining the resources of all of the producers into a program that would promote the use of lumber to combat the growing use of both wood and non-wood substitute materials in construction. The second effort that needs to be made is for the individual firms, after adopting a product concept, to develop product promotion and advertising consistent with the changed marketing program.

This writer certainly does not have all the answers to the problems facing the Arizona lumber industry. It is doubtful that any one person can fully understand all of

the forces at work in the industry due to its complexity and its involvement with other industries. It is hoped that this study will shed some light on the problems and will be of assistance to the industry leaders as they plan the future of their firms and the industry in Arizona.

APPENDIX A

TECHNICAL TERMINOLOGY

APPENDIX A

TECHNICAL TERMINOLOGY

Air dried. Lumber or other wood products that have been dried by exposure to natural atmospheric conditions outdoors or in an unheated shed.

Blemish. In grading lumber, anything marring the appearance that is not classifiable as a defect.

Board. Yard lumber that is less than 2 inches thick and more than 8 inches wide. A term usually applied to one-inch stock of all widths and lengths.

Board foot. A unit of measurement represented by a board 1 foot long, 1 foot wide and 1 inch thick. In finished or surfaced lumber, the board-foot measure is based on the measurement before surfacing or other finishing. In practice the working unit is 1,000 board feet.

Board measure. A unit of measurement of the volume in board feet of logs or lumber.

Boards, common. The term applied to various grades of 1-inch lumber of a quality inferior to finish lumber.

Bolt. 1. A segment of a log or one sawn or split from a short log. A term usually applied to blocks from which shingles, staves, and vehicle stock are manufactured. A stave bolt must contain at least three staves and must equal not more than half the round bolt from which it was split. 2. Any short log, as a pulpwood or veneer bolt.

Cant. A large timber, cut by the headsaw, which is then further reduced into lumber, usually by another saw in the same mill.

Check. A lengthwise separation of the wood, which usually extends across the rings of annual growth, commonly resulting from stresses set up in the wood during seasoning.

Chip. Hogged wood ready for cooking into pulp.

Chipboard. In the furniture and allied industries, any board made from wood particles and resins.

Clear. Of lumber, free of all blemishes or defects.

Commercial forest land. Forest land bearing or capable of bearing timber of commercial character and economically available now or prospectively for commercial use and not otherwise withdrawn from such use.

Conifer. A tree belonging to the order Coniferae usually evergreen with cones and needle-shaped leaves, and producing wood known commercially as "softwood."

Defect. Any irregularity or imperfection in a tree, log, piece of product, or lumber that reduces the volume of sound wood or lowers its durability, strength, or utility value. Defects in lumber may result from such factors as insect or fungus attack, growth conditions and abnormalities, manufacturing or seasoning practices, etc.

Dimension. All yard lumber except boards, strips, and timbers, that is, yard lumber two inches or more but less than five inches thick, and of any width.

Dry kiln. A structure in which lumber is seasoned artificially.

Dunnage. Lumber used in separating and binding ship cargoes. Stakes and strips used in holding lumber on open cars, and any other lumber that may be needed to protect such shipments.

Edger. A machine used in sawmills to square-edge waney lumber and also to rip lumber. It consists of a frame supporting an arbor and on it are mounted several circular saws, feed rolls, press rolls, and transmission gear.

Edgings. The waste strips cut in the process of squaring boards.

Factory and shop. A classification in the grading system for softwood lumber.

Finish. The higher grades of lumber.

Finished size. The net dimensions after surfacing.

Forest land. Land bearing forest growth or land from which the forest has been removed but which shows evidence of past forest occupancy and which is not now in other use.

Forest management. The application of business methods and technical forestry principles to the operation of a forest property.

Grades. A system of classification of lumber based on quality. That used for a given species is given in the grading rules of a lumber association. A considerable degree of uniformity as between the different associations is maintained through the use of American Lumber Standards as a recognized guide.

Softwood lumber is classified into yard, structural, and factory or shop lumber. Yard and structural are graded by the quality of the piece as a whole. Factory and shop is graded on the percent of area that will produce cuttings of specified size and quality. Yard lumber grades, as established in American Lumber Standards, include four grades of Select (A, B, C, D), of Common (1, 2, 3, 4, 5), not of finishing quality but usable, and allowing for waste in the three lowest grades. Structural and factory and shop lumber are graded variously according to intended use.

Green lumber. Lumber, the moisture content of which is greater than air-dried lumber. Unseasoned lumber.

Hog. A device used in a sawmill to reduce waste pieces of lumber and slabs to chip form for fuel or other use.

Joist. A piece of dimension lumber 2 inches to 5 inches thick and 4 or more inches wide; commonly a timber used to support the floor of a building.

Kiln-dried. A term applied to wood dried in a kiln.

Lagging. Small round or split poles, slabs, rough lumber, or brush placed above the caps and along the sides of mining props.

Laminated. A piece of wood built up of plies or laminations of lumber or veneer that have been joined with either glue or mechanical fastenings, with the grain of all plies parallel to each other.

The term is most frequently applied when the plies are too thick to be classified as veneer and when the grain of all plies is parallel.

Lumber. The product of the saw and planing mill, not further manufactured than by sawing, resawing, and passing lengthwise through a standard planing machine, cross-cut to length, and matched.

Maturity. For a given species or stand, the approximate age beyond which growth falls off or decay begins to increase at a rate likely to assume economic importance.

Mill run. As generally understood, all the lumber output of a sawmill that has a sale value.

Milling-in-transit. Privilege granted by railroads, by which lumber shippers may stop loaded cars between loading point and destination for purpose of further manufacture, without losing advantage of the through rates.

Millwork. Generally all building materials made of finished wood in millwork plants or planing mills. The term includes such items as sash, doors, blinds, frames, cornices, columns, mantels, panelwork and other items of exterior and interior trim but not the material from which such trim is made.

Moisture content. The amount of water contained in the wood usually expressed as a percentage of the weight of the oven-dry wood.

Nominal measure. In the European import lumber trade, the full measure of a board before it is surfaced.

Particleboard. A reaggregation of wood particles such as sawdust, shavings, or chips which are bonded together under heat and pressure by synthetic resins to form a board whose thickness typically varies from $\frac{1}{4}$ inch to 1-inch.

Piling. Round timbers to be driven into the ground to support other structures.

Plywood. An assembly product constructed of three or more layers of veneer joined with glue and usually laid with the grain of adjoining plies at right angles. Almost always an odd number of plies are used to give balanced construction.

Pole. A young tree 4 inches or more in diameter breast high. The maximum size of poles is usually though not invariably taken to be some diameter breast high between 8 and 12 inches.

Pulp, wood. Mechanically ground or chemically digested wood used in the manufacture of paper and allied products; bleached and purified chemical wood pulp is also widely employed for rayon and other chemical uses.

Resaw. To reduce the thickness of boards, planks, slabs, or other material by cutting into two or more thinner pieces on a resaw.

Rip. To reduce the width of a board by sawing lengthwise; i. e., parallel to the fibers.

Saw log. A log large enough to produce lumber or other products that can be sawed. Its size and quality vary with the utilization practices of the region.

Sawmill. A plant at which logs are sawed into salable products. It includes all the machinery and buildings necessary for the operation of the plant.

Sawtimber. Trees that will yield logs suitable in size and quality for the production of lumber.

Sawyer. One who controls the carriage and other machinery in sawing logs into lumber.

Seasoning. The process of drying (curing) lumber or other forms of wood for better utilization, by natural seasoning (air or underground drying) or artificial seasoning (kiln drying, electrical drying, oil drying, etc.)

Select. A standard grade classification of softwood yard lumber.

Selective logging. Removal of mature timber, usually the oldest or largest trees, either as single scattered trees or in small groups at relatively short intervals, commonly 5 to 20 years, repeated indefinitely, by means of which the continuous establishment of natural reproduction is encouraged and an uneven-aged stand is maintained.

Sheathing. Lumber, other than siding, used to cover the exterior side of buildings.

Softwood. Generally, one of the botanical group of trees that in most cases have needle or scale-like leaves; the conifers; also, the wood produced by such trees.

Stud. A component part of house framing. Usually 2" x 3" or 2" x 4"--8'.

Surface. To plane one or more sides of a board, plank, timber or other sawed material.

Sustained yield. As applied to a policy, method, or plan of forest management, implies continuous production with the aim of achieving, at the earliest practicable time, an approximate balance between net growth and harvest, either by annual or somewhat longer periods.

Timber. A term loosely applied to forest stands or their products; often to wood in forms suitable for heavy construction, as for houses, ships and bridges. Specifically, sawed lumber 5 by 5 inches or more in breadth and thickness; or, in English markets, sawed material more than $4\frac{1}{2}$ inches thick and 6 inches wide.

Trimmer. A battery of cut-off saws used to trim the ends of lumber to even lengths.

Veneer. A thin sheet of wood cut on a veneer machine. There are three kinds of veneers: sawed, sliced, and rotary cut.

Virgin forest. A mature or overmature forest growth essentially uninfluenced by human activity.

Watershed management. Application of business methods and technical principles to the handling of all the renewable resources in a watershed to assure maximum supplies of usable water, desirable waterflow, prevention and control of erosion, and the reduction of flood and sediment damages.

Source: Forest Terminology, A Glossary of Technical Terms Used in Forestry (3rd ed.; Washington: Society of American Foresters, 1964).

APPENDIX B

SECTIONS AND REGIONS OF THE UNITED STATES

APPENDIX B

SECTIONS AND REGIONS OF THE UNITED STATES

PACIFIC COAST SECTION
- Pacific Northwest Region
  - Alaska
  - Oregon
  - Washington
- Pacific Southwest Region
  - California
  - Hawaii

ROCKY MOUNTAIN SECTION
- Northern Rocky Mountain Region
  - Idaho
  - Montana
  - Wyoming
- Southern Rocky Mountain Region
  - Arizona
  - Colorado
  - Nevada
  - New Mexico
  - Utah

NORTH SECTION
- Lake States Region
  - Michigan
  - Minnesota
  - North Dakota
  - South Dakota
  - Wisconsin
- Central States Region
  - Illinois
  - Indiana
  - Iowa
  - Kansas
  - Kentucky
  - Missouri
  - Nebraska
  - Ohio

Middle Atlantic Region
- Delaware
- Maryland
- New Jersey
- New York
- Pennsylvania
- West Virginia

New England Region
- Connecticut
- Maine
- Massachusetts
- New Hampshire
- Rhode Island
- Vermont

SOUTH SECTION

West Gulf Region
- Arkansas
- Louisiana
- Oklahoma
- Texas

Central Gulf Region
- Alabama
- Mississippi
- Tennessee

East Gulf Region
- Florida
- Georgia

South Atlantic Region
- North Carolina
- South Carolina
- Virginia

Source: This arrangement of states into sections and regions is the same as used in: U. S. Forest Service, Timber Trends in the United States, Forest Resource Report No. 17 (Washington: U. S. Government Printing Office, 1965).

APPENDIX C

DATA FROM PUBLISHED SOURCES

APPENDIX C

DATA FROM PUBLISHED SOURCES

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TABLE 1. Lumber production, imports, and exports, 1899-1964 (billion board feet).

Year	Domestic Production	Imports	Exports
1899	35.1	0.7	1.5
1905	43.5	0.8	1.8
1910	44.5	1.0	2.3
1915	37.0	1.1	1.3
1920	35.0	1.4	1.7
1925	41.0	1.8	2.6
1930	29.4	1.2	2.4
1935	22.9	0.4	1.3
1940	31.2	0.7	1.0
1941	36.5	1.4	0.7
1942	36.3	1.5	0.5
1943	34.3	0.9	0.3
1944	32.9	1.0	0.4
1945	28.1	1.1	0.4
1946	34.1	1.2	0.6
1947	35.4	1.3	1.4
1948	37.0	1.9	0.6
1949	32.2	1.6	0.7
1950	38.0	3.4	0.5
1951	37.2	2.5	1.0
1952	37.5	2.5	0.7
1953	36.7	2.8	0.6
1954	36.4	3.1	0.7
1955	37.4	3.6	0.8
1956	38.2	3.4	0.8
1957	32.9	3.0	0.8
1958	33.4	3.4	0.7
1959	37.2	4.1	0.8
1960	32.9	3.9	0.9
1961	31.9	4.3	0.8
1962	33.2	4.9	0.8
1963*	34.6	5.3	0.9
1964*	36.8	5.5	1.0

*Preliminary estimates by National Lumber Manufacturers Association.

Source: Dwight Hair and Alice H. Ulrich, The Demand and Price Situation for Forest Products--1964, U. S. Forest Service Miscellaneous Publication No. 983 (Washington: U. S. Government Printing Office, 1964), p. 36.

TABLE 2. Area of commercial forest land in the United States by ownership and region, January 1, 1963 (thousand acres)

Region	All Ownership	Federal					State
		Total	National Forests	Bureau Land Mgmt	Indian	Misc.	
Total North	171,789	12,508	10,265	81	1,198	964	12,751
Per cent of total	100.0	7.3	6.0		0.7	0.6	7.4
Total South	201,069	14,062	10,476	27	251	3,308	2,164
Per cent of total	100.0	7.0	5.2		0.1	1.6	1.1
Total West	135,987	86,606	76,063	5,318	5,012	213	5,929
Per cent of total	100.0	63.7	55.9	3.9	3.7	0.2	4.4
Total all regions	508,845	113,176	96,804	5,426	6,461	4,485	20,844
Per cent	100.0	22.2	19.0	1.1	1.2	0.9	4.1

Source: U. S. Forest Service, Timber Trends in the United States, Forest Resource Report No. 17 (Washington: U. S. Government Printing Office, 1965), pp. 141-42.

TABLE 2.--Continued

Region	County & Municipal	Forest Industry				Farmer	Misc. Private
		Total	Pulp & Paper	Lumber	Other		
Total North	6,748	14,316	10,797	2,996	523	55,503	69,963
Per cent of total	3.9	8.3	6.3	1.7	.03	32.4	40.7
Total South	656	37,422	21,614	12,551	3,257	78,897	67,868
Per cent of total	0.3	18.6	10.8	6.2	1.6	39.2	33.8
Total West	444	14,890	2,611	10,566	1,713	16,617	11,501
Per cent of total	0.3	10.9	1.9	7.8	1.2	12.2	8.5
Total all regions	7,848	66,628	35,022	26,113	5,493	151,017	149,332
Per cent	1.5	13.1	6.9	5.1	1.1	29.7	29.4

Note: Percentage columns may not total 100.0 due to rounding.

TABLE 3. Estimated total value added and employment attributed to timber in timber-based economic activities in the United States, 1958.

Kind of Timber-based Economic Activity	Value Added in Millions of $	Per Cent	Employment in Thousands	Per Cent
Forest Management	998	4.0	82	2.5
Harvesting	1,509	6.1	342	10.3
Primary Manufacturing				
Sawmills & planing mills	1,087	4.4	239	7.2
Veneer & plywood	337	1.3	51	1.5
Pulp, paper	2,316	9.4	185	5.6
All other	116	0.5	14	0.4
Total	3,856	15.6	489	14.7
Secondary Manufacturing				
Millwork & pre-fab wood products	410	1.6	58	1.8
Wooden containers	152	0.6	33	1.0
Furniture	820	3.3	134	4.0
Paper & paperboard	2,027	8.2	229	6.9
Fibers, plastics, textiles	1,452	5.9	240	7.2
All other	585	2.4	99	3.0
Total	5,446	22.0	793	23.9
Construction	7,610	30.8	840	25.2
Transportation and Marketing				
Transportation	1,692	6.8	192	5.8
Wholesale trade	1,357	5.5	189	5.7
Retail trade	2,287	9.2	395	11.9
Total	5,336	21.5	776	23.4

TABLE 3. Continued.

Kind of Timber-based Economic Activity	Value Added in Millions of $	Per Cent	Employment in Thousands	Per Cent
Total, All Kinds	24,755	100.0	3,322	100.0

Source: Dwight Hair, The Economic Importance of Timber in the United States, Forest Service Miscellaneous Publication 941 (Washington: U. S. Government Printing Office, 1963), p. 3.

TABLE 4. Lumber consumption in the United States, 1900-1962 (billion board feet).

Year	Estimated Consumption	Year	Estimated Consumption	Year	Estimated Consumption
1900	41	1921	28	1942	44
1901	42	1922	35	1943	39
1902	42	1923	40	1944	35
1903	42	1924	38	1945	31
1904	42	1925	40	1946	34
1905	42	1926	39	1947	34
1906	45	1927	36	1948	36
1907	45	1928	38	1949	34
1908	41	1929	34	1950	41
1909	44	1930	30	1951	39
1910	43	1931	21	1952	42
1911	41	1932	17	1953	39
1912	43	1933	19	1954	39
1913	42	1934	18	1955	40
1914	39	1935	23	1956	41
1915	37	1936	26	1957	35
1916	40	1937	26	1958	36
1917	36	1938	24	1959	41
1918	32	1939	28	1960	36
1919	34	1940	34	1961	36
1920	35	1941	36	1962	37

Arithmetic mean = 35.98 billion board feet.

Arithmetic mean (excluding 1931-1939) = 38.24 billion board feet.

Sources: Data for years 1900-1952: U. S. Forest Service, Timber Resources for America's Future, Forest Resource Report No. 14 (Washington: U. S. Government Printing Office, 1958), p. 419. Data for years 1953-1962: U. S. Forest Service, Timber Trends in the United States, Forest Resource Report No. 17 (Washington: U. S. Government Printing Office, 1965), p. 220.

TABLE 5. Lumber consumption, net imports, and domestic production, by softwoods and hardwoods, 1920-2000 (billion board feet).

Year	All Species			Softwoods			Hardwoods		
	Consumption	Net[a] Imports	Domestic Production	Consumption	Net[a] Imports	Domestic Production	Consumption	Net[a] Imports	Domestic Production
1920	34.7	(0.3)	35.0	27.4	(0.2)	27.6	7.3	(0.1)	7.4
1930	28.1	(1.2)	29.3	22.4	(0.8)	23.2	5.7	(0.4)	6.1
1940	31.0	(0.2)	31.2	25.5	(0.1)	25.6	5.5	(0.1)	5.6
1950	40.9	2.9	38.0	33.3	2.7	30.6	7.6	.2	7.4
1952	41.5	1.8	39.7	33.2	1.7	31.5	8.1	.1	8.0
1960	36.0	3.1	32.9	29.6	2.9	26.7	6.4	.1	6.2
1962	37.3	4.1	33.2	30.8	4.0	26.8	6.5	.2	6.4
PROJECTIONS									
1970	39.7	5.1	34.6	32.2	4.9	27.3	7.5	0.2	7.3
1980	43.4	5.8	37.6	35.2	5.5	29.7	8.2	.3	7.9
1990	48.0	6.5	41.5	38.9	6.1	32.8	9.1	.4	8.7
2000	53.5	7.0	46.5	43.3	6.5	36.8	10.2	.5	9.7

[a]Figures in parentheses are net exports.

TABLE 5. Continued.

Individual columns may not add to totals because of rounding.

Source: U. S. Forest Service, Timber Trends in the United States, Forest Resource Report No. 17 (Washington: U. S. Government Printing Office, 1965), p. 42.

TABLE 6. Apparent consumption of timber products in the United States by major products, 1920-1962 (million cubic feet, roundwood equivalent and per cent of total consumption).

Year	Total Apparent Consumption[b]	Industrial Roundwood[a]								Fuel Wood	
		Saw Logs[c]		Veneer Logs		Pulpwood		Other Products[d]			
		Mil Cu Ft	Per Cent	Mil Cu Ft	Per Cent	Mil Cu Ft	Per Cent	Mil Cu Ft	Per Cent	Mil Cu Ft	Per Cent
1920	12,040	5,380	44.6	80	0.7	625	5.2	1,890	15.7	4,065	33.8
1925	11,935	6,255	52.4	135	1.1	825	6.9	1,495	12.6	3,225	27.0
1930	10,495	4,385	41.8	150	1.4	975	9.3	1,195	11.4	3,790	36.1
1935	10,225	3,630	35.5	140	1.4	1,050	10.3	895	8.7	4,510	44.1
1940	11,795	5,340	45.2	230	2.0	1,370	11.6	965	8.2	3,890	33.0
1945	10,520	4,745	45.1	240	2.3	1,715	16.3	845	8.0	2,975	28.3
1950	12,230	6,360	52.0	355	2.9	2,475	20.2	770	6.3	2,270	18.6
1955	12,220	6,215	50.8	635	5.2	2,995	24.5	630	5.1	1,745	14.4
1956	12,460	6,335	50.7	655	5.3	3,210	25.8	605	4.9	1,655	13.3
1957	11,270	5,435	48.2	630	5.6	3,060	27.2	580	5.1	1,565	13.9
1958	11,200	5,575	49.8	695	6.2	2,890	25.8	560	5.0	1,480	13.2
1959	12,150	6,255	51.5	835	6.9	3,135	25.8	535	4.4	1,390	11.4
1960	11,335	5,560	49.1	800	7.1	3,165	27.9	510	4.5	1,300	11.4
1961	11,285	5,485	48.6	860	7.6	3,235	28.7	490	4.3	1,215	10.8
1962	11,800	5,920	50.2	965	8.2	3,325	28.2	465	3.9	1,125	9.5

[a]Includes all products, except fuelwood, commonly cut from round sections of both softwood and hardwood trees.

TABLE 6.--Continued

[b]Includes total domestic production plus net imports.

[c]Saw logs are used primarily to make lumber.

[d]Includes cooperage, poles and pilings, posts, shingle bolts, excelsior bolts, etc.

Source: U. S. Forest Service, Timber Trends in the United States, Forest Resource Report No. 17 (Washington: U. S. Government Printing Office, 1965), pp. 219-20.

TABLE 7. Lumber production in Arizona, 1946-1965 (board foot measure).

Year	Production	Year	Production
1946	240,700,000	1959	357,300,000
1953	295,000,000	1960	330,000,000
1954	258,200,000	1961	326,000,000
1955	254,000,000	1962	326,000,000
1956	328,900,000	1963	357,000,000
1957	326,200,000	1964	411,000,000
1958	302,600,000	1965	365,000,000

Source: Statistical Yearbook, 1964-65 (Portland, Oregon: Western Wood Products Association).

TABLE 8. Wholesale prices for selected lumber products, by month, 1959-1965 (dollars per thousand board feet).

Month	No. 3 Common Pine Boards	No. 4 Common Pine Boards	No. 2 Pine Shop	Std & Btr Doug-fir & Larch Dimension	Std & Btr White Fir Dimension
1959					
January	$74.94	$59.95	$100.02	$72.26	$66.73
February	73.47	60.64	99.06	73.33	69.51
March	75.97	62.03	99.42	75.91	69.69
April	80.29	63.80	102.75	79.82	73.20
May	82.46	65.02	105.91	81.73	75.62
June	83.54	66.20	117.30	84.46	78.76
July	82.31	67.82	109.46	83.56	77.00
August	81.03	67.84	112.27	85.73	78.71
September	79.10	66.62	113.15	86.93	78.83
October	76.65	65.23	112.75	82.87	74.97
November	75.66	64.12	113.87	79.57	71.98
December	75.50	61.32	113.12	75.85	69.72
1960					
January	76.06	60.21	112.77	75.62	68.27
February	78.42	61.47	113.28	78.58	70.75
March	79.68	61.46	113.18	76.64	69.68
April	80.72	60.85	112.95	78.09	71.39
May	79.99	57.62	113.68	76.82	71.54
June	78.62	56.34	112.00	76.50	70.12
July	75.95	52.98	109.91	76.01	69.32
August	72.28	48.12	103.32	73.40	65.54
September	69.67	44.05	95.80	73.48	65.57
October	69.65	40.98	91.99	73.13	64.32
November	69.56	42.67	90.02	69.48	60.94
December	68.75	39.85	87.41	68.69	60.16
1961					
January	70.16	42.27	86.33	68.83	61.58
February	70.22	41.75	83.49	68.97	61.44
March	69.72	42.02	83.55	71.40	58.77
April	69.89	42.35	84.11	72.38	62.60
May	73.37	44.92	84.02	75.40	67.21
June	73.77	45.96	85.93	75.85	67.11
July	72.14	45.41	86.13	76.26	67.31
August	68.81	44.39	87.00	75.94	67.23
September	66.68	43.53	86.59	75.68	66.27
October	66.83	44.38	86.85	74.54	64.17
November	66.03	43.44	85.77	72.31	62.57
December	65.74	44.86	87.13	71.29	62.65

TABLE 8--Continued

Month	No. 3 Common Pine Boards	No. 4 Common Pine Boards	No. 2 Pine Shop	Std & Btr Doug-fir & Larch Dimension	Std & Btr White Fir Dimension
1962					
January	64.61	46.27	87.51	69.40	63.86
February	65.69	46.66	86.82	71.00	63.61
March	67.38	47.24	86.87	71.16	66.19
April	70.91	49.43	89.93	73.54	67.81
May	71.49	52.00	92.13	75.45	69.19
June	69.59	50.73	92.07	74.95	68.62
July	69.08	49.83	92.79	76.00	71.04
August	67.76	52.47	92.51	78.64	70.81
September	66.03	54.51	93.07	78.81	67.80
October	66.25	53.80	92.46	76.78	65.87
November	65.15	53.32	92.85	74.67	64.08
December	65.26	52.16	93.42	70.30	63.17
1963					
January	64.95	51.04	92.93	73.25	64.06
February	65.11	50.79	93.35	71.08	63.83
March	66.06	50.99	92.97	71.68	64.58
April	67.72	50.13	95.25	74.89	65.62
May	68.53	51.70	95.90	76.12	66.51
June	69.09	52.10	96.75	77.17	68.44
July	70.79	54.20	97.89	80.48	70.03
August	72.16	55.50	98.73	85.19	73.38
September	70.56	55.98	99.19	84.73	70.20
October	65.96	51.93	99.66	75.19	64.34
November	64.62	49.68	99.06	75.34	63.23
December	63.50	50.13	99.13	74.19	63.80
1964					
January	63.07	47.37	100.23	74.30	63.54
February	63.67	47.54	100.52	74.95	63.99
March	66.45	48.47	101.74	78.44	67.99
April	68.05	49.12	102.65	79.09	70.98
May	69.92	49.17	105.50	79.73	71.26
June	69.01	48.46	106.39	79.52	69.75
July	67.16	46.23	107.71	79.27	68.24
August	65.52	46.88	107.30	77.62	67.09
September	63.73	44.50	107.44	77.43	66.81
October	63.52	44.67	107.21	78.46	65.97
November	62.63	43.54	106.48	76.67	65.47
December	63.15	43.94	105.95	74.71	65.62

TABLE 8--Continued

Month	No. 3 Common Pine Boards	No. 4 Common Pine Boards	No. 2 Pine Shop	Std & Btr Doug-fir & Larch Dimension	Std & Btr White Fir Dimension
1965					
January	63.66	44.12	105.95	74.49	66.80
February	68.48	47.87	105.88	79.35	69.89
March	70.55	46.48	106.63	78.68	70.25
April	70.70	45.40	107.21	77.90	69.48
May	70.33	44.87	106.85	77.90	69.64
June	68.28	44.62	106.99	77.94	69.65
July	66.65	44.39	106.11	76.84	69.04
August	66.34	44.82	105.66	78.59	71.26
September	67.53	45.88	105.81	81.75	72.89
October	67.07	46.64	106.00	80.95	72.41
November	65.55	45.89	105.26	79.24	68.89
December	63.91	45.44	104.53	77.15	67.88

Source: U. S. Bureau of Labor Statistics, Wholesale Prices and Price Indexes (Washington: U. S. Government Printing Office, monthly issues, 1959-1965).

TABLE 9. Indexes of wholesale prices of selected lumber items, by month, 1959-1965.

Month	1957-1959 = 100			January, 1959 = 100	
	No. 3 Common Pine Boards	No. 4 Common Pine Boards	No. 2 Pine Shop	Std & Btr Doug-fir & Larch Dimension	Std & Btr White Fir Dimension
1959					
January	102.3	97.7	99.2	100.0	100.0
February	100.3	99.5	98.2	101.5	104.2
March	103.7	101.0	98.6	105.1	104.4
April	109.7	103.9	101.9	110.5	109.7
May	112.5	106.0	105.0	113.1	113.3
June	114.0	107.9	116.2	116.9	118.0
July	112.2	110.5	108.6	115.6	115.4
August	110.6	110.5	111.1	118.6	118.0
September	107.9	108.7	112.0	120.3	118.1
October	104.7	106.1	111.8	114.7	112.4
November	103.2	104.5	112.9	110.1	107.9
December	103.1	100.0	112.0	105.0	104.5
1960					
January	103.8	99.0	111.8	104.7	102.3
February	107.1	100.1	112.2	108.8	106.0
March	108.8	100.1	112.2	106.1	104.4
April	110.2	100.1	111.9	108.1	107.0
May	109.2	94.7	112.5	106.3	107.2
June	107.3	92.5	111.0	105.9	105.1
July	103.7	86.2	108.9	105.2	103.9
August	98.6	78.4	102.2	101.6	98.2
September	95.0	71.8	94.9	101.7	98.3
October	95.0	66.8	91.2	101.2	96.4
November	94.9	69.5	89.0	96.1	91.3
December	94.0	65.0	86.6	95.0	90.2
1961					
January	95.9	68.9	85.4	95.2	92.3
February	96.0	68.0	82.6	95.4	92.1
March	95.3	68.5	82.8	98.8	88.1
April	95.6	69.0	83.1	100.1	93.8
May	100.1	73.2	83.1	104.3	100.7
June	100.8	74.8	85.1	104.9	100.6
July	98.6	73.9	85.4	105.5	100.9
August	94.1	72.3	86.1	105.1	100.7
September	91.1	70.9	85.9	104.7	99.3

TABLE 9--Continued

Month	1957-1959 = 100			January, 1959 = 100	
	No. 3 Common Pine Boards	No. 4 Common Pine Boards	No. 2 Pine Shop	Std & Btr Doug-fir & Larch Dimension	Std & Btr White Fir Dimension
October	91.3	72.3	86.0	103.1	96.2
November	90.0	70.8	85.0	100.0	93.8
December	89.8	73.1	86.1	98.6	93.9
1962					
January	88.3	75.5	86.7	96.0	95.7
February	89.7	76.1	86.0	98.2	95.3
March	92.0	77.0	86.0	98.5	99.2
April	96.9	80.6	89.1	101.8	101.6
May	97.7	84.8	91.2	104.4	103.7
June	95.1	82.1	91.2	103.7	102.8
July	94.4	81.3	91.9	105.2	106.5
August	92.6	85.6	91.6	108.8	106.1
September	90.2	88.9	92.2	109.1	101.6
October	90.5	87.7	91.6	106.3	98.7
November	89.0	87.0	91.9	103.3	96.0
December	89.2	85.1	92.5	97.3	94.7
1963					
January	88.7	83.2	92.0	101.4	96.0
February	88.9	82.8	92.4	98.4	95.7
March	90.2	83.1	92.0	99.2	96.8
April	92.5	81.7	94.3	103.7	98.3
May	93.6	84.3	94.9	105.4	99.7
June	94.4	85.0	95.8	106.8	102.6
July	96.7	88.4	96.9	111.4	104.9
August	98.6	90.5	97.7	117.9	110.0
September	96.4	91.3	98.2	117.3	105.2
October	90.1	84.7	98.7	104.1	96.4
November	88.3	81.0	98.1	104.3	94.8
December	86.8	81.7	98.3	102.7	95.6
1964					
January	86.2	77.2	99.2	102.8	95.2
February	87.0	77.5	99.5	103.7	95.2
March	90.8	79.0	100.7	108.5	101.9
April	93.0	80.1	101.6	109.4	106.4
May	95.5	80.2	104.4	110.3	106.8
June	94.3	79.0	105.3	110.0	104.5

TABLE 9--Continued

Month	1957-1959 = 100			January, 1959 = 100	
	No. 3 Common Pine Boards	No. 4 Common Pine Boards	No. 2 Pine Shop	Std & Btr Doug-fir & Larch Dimension	Std & Btr White Fir Dimension
July	91.8	75.4	106.6	109.7	102.3
August	89.5	76.5	106.2	107.4	100.5
September	87.1	72.6	106.4	107.2	100.5
October	86.8	72.9	106.1	108.6	100.1
November	85.6	71.0	105.4	106.1	98.1
December	86.3	71.7	104.9	103.4	98.3
1965					
January	87.0	72.0	104.9	103.1	100.1
February	93.5	78.1	104.8	109.8	104.7
March	96.6	76.4	105.6	108.9	105.3
April	96.6	74.1	106.1	107.8	104.1
May	96.1	73.2	105.8	107.8	104.3
June	93.3	72.8	105.9	107.9	104.4
July	91.1	72.4	105.0	106.4	103.4
August	90.6	73.1	104.6	108.8	106.8
September	92.3	74.8	104.7	113.1	109.2
October	91.6	76.1	104.9	112.0	108.5
November	89.5	74.8	104.2	109.7	103.2
December	87.3	74.1	103.5	106.8	101.7

Source: U. S. Bureau of Labor Statistics, Wholesale Prices and Price Indexes (Washington: U. S. Government Printing Office, monthly issues, 1959-1965).

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DATA FROM ORIGINAL SOURCES

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TABLE 1. Distribution of invoice sizes, 1959-1965.

Class Size (board feet)	Number of Invoices							
	1959		1961		1963		1965	
	f	%	f	%	f	%	f	%
Under 5,000	23	5.0	56	12.0	111	15.3	107	12.0
5,000-9,999	44	9.6	52	11.2	119	16.4	117	13.1
10,000-14,999	46	10.1	53	11.4	86	11.8	118	13.2
15,000-19,999	89	19.5	84	18.0	120	16.5	142	15.9
20,000-24,999	138	30.3	82	17.6	148	20.3	160	17.9
25,000-29,999	74	16.2	78	16.7	45	6.2	87	9.7
30,000-34,999	38	8.4	44	9.4	54	7.4	85	9.5
35,000-39,999	0	-	11	2.4	36	4.9	52	5.8
40,000- and over	4	0.9	6	1.3	9	1.2	26	2.9
Total	456	100.0	466	100.0	728	100.0	894	100.0
Mean =	19,749		18,832		17,091		19,089	
Median =	20,748		19,433		17,896		18,616	
Standard deviation =	9,334		10,089		10,472		10,969	

TABLE 2. Percentage distribution of types and grades of lumber marketed by Arizona producers, 1959-1965.

Type of Lumber	1959	1961	1963	1965
Selects				
1 inch	0.8	2.2	2.9	0.6
2 inch	-	-	-	-
4/4-8/4	5.6	3.2	3.8	6.4
	6.4	5.4	6.7	7.0
Shop				
1 inch	1.6	1.2	1.5	0.8
2 inch	-	0.3	0.1	0.1
4/4-8/4	21.1	15.8	14.0	19.9
	22.7	17.3	15.6	20.8
Commons				
Boards				
2 and Better				
1 inch	0.7	0.7	1.3	2.3
4/4-7/4	2.6	1.6	1.2	1.8
	3.3	2.3	2.5	4.1
3 and Poorer				
1 inch	22.3	30.4	28.7	19.8
4/4-7/4	31.5	24.3	19.6	20.2
	53.8	54.7	48.3	40.0
Dimension				
2 inch				
Standard and Better	7.3	10.1	12.6	14.8
Utility	5.1	7.8	10.2	8.4
Economy	0.8	1.7	2.7	3.2
3 inch	0.6	0.7	1.1	1.5
	13.8	20.3	26.6	27.9
Mill Run	-	-	0.3	0.2
Total	100.0	100.0	100.0	100.0

TABLE 3. Percentage distribution of thicknesses of all lumber (6/4 resawn included with 1 inch class) marketed by Arizona lumber producers, 1959-1965.

Thickness (in inches)	1959	1961	1963	1965
1 (including 6/4 resawn)	47.1	54.6	52.9	39.9
4/4	6.1	2.8	1.7	2.5
5/4	9.2	6.7	6.1	10.0
6/4	20.1	14.2	10.4	16.6
7/4	0.4	0.1	1.4	0.7
8/4	0.5	0.2	-	0.2
5/4 and 6/4	1.9	0.4	0.7	0.4
4/4 to 6/4	0.7	0.4	0.1	1.1
2	13.2	19.9	25.6	26.7
3 and over	0.6	0.7	1.1	1.5
Random thicknesses	0.2	-	-	0.4
Total	100.0	100.0	100.0	100.0

TABLE 4. Percentage distribution of thicknesses of all lumber marketed by Arizona producers, 1959-1965.

Thickness (in inches)	1959	1961	1963	1965
1	25.4	34.5	34.6	23.5
4/4	6.1	2.8	1.7	2.5
5/4	9.2	6.7	6.1	10.0
6/4 (including resawn)	41.8	34.3	28.7	33.0
7/4	0.4	0.1	1.4	0.7
8/4	0.5	0.2	-	0.2
5/4 and 6/4	1.9	0.4	0.7	0.4
4/4 to 6/4	0.7	0.4	0.1	1.1
4/4 to 8/4 (no specified thickness)	0.2	-	-	0.4
2	13.2	19.9	25.6	26.7
3 and over	0.6	0.7	1.1	1.5
Total	100.0	100.0	100.0	100.0

TABLE 5. Percentage distribution of resawn lumber, by thickness, marketed by Arizona producers, 1959-1965.

Thickness (in inches)	Per cent of Resawn Lumber				Per cent of all Lumber			
	1959	1961	1963	1965	1959	1961	1963	1965
1	1.0	3.4	4.0	3.3	0.2	0.7	0.8	0.6
5/4	2.2	2.4	0.8	1.0	0.5	0.5	0.1	0.2
6/4	95.7	94.2	94.4	90.2	21.7	20.1	18.3	16.4
2	1.1	-	0.8	5.5	0.2	-	0.1	1.0
Total	100.0	100.0	100.0	100.0	22.6	21.3	19.3	18.2

TABLE 6. Percentage distribution of grades of 6/4 resawn lumber marketed by Arizona producers, 1959-1965.

Grades	% of 6/4 Resawn Lumber				% of all Lumber			
	1959	1961	1963	1965	1959	1961	1963	1965
Select:								
D & Btr & Moulding	*	-	*	-	*	-	*	-
Shop:								
3 and Better	1.0	-	-	1.3	0.2	-	-	0.2
Shop Outs	-	-	-	0.1	-	-	-	*
Commons:								
2 and Better	5.9	6.8	5.7	5.9	1.3	1.4	1.0	1.0
3 and Poorer	93.1	93.2	94.3	92.7	20.2	18.7	17.3	15.2
Total	100.0	100.0	100.0	100.0	21.7	20.1	18.3	16.4

*Less than 0.05 per cent.

TABLE 7. Percentage distribution of grades of 1 inch lumber (including 6/4 resawn) marketed by Arizona lumber producers, 1959-1965.

Grade	Per cent of Boards (including 6/4 resawn)				Per cent of all Lumber			
	1959	1961	1963	1965	1959	1961	1963	1965
Select								
D & Btr & Moulding	1.8	4.1	5.5	1.6	0.8	2.2	2.9	0.6
Shop								
3 and Better	4.1	1.9	1.9	2.2	1.9	1.0	1.0	0.9
Shop Outs	-	0.2	0.8	0.4	-	0.1	0.4	0.2
Commons:								
2 and Better	4.8	3.7	4.5	8.1	2.3	2.0	2.3	3.2
3 and Poorer	89.3	90.1	86.8	87.6	42.1	49.3	46.0	35.0
Mill Run	-	-	0.5	0.1	-	-	0.3	*
Total	100.0	100.0	100.0	100.0	47.1	54.6	52.9	39.9

*Less than 0.05 per cent.

TABLE 8. Percentage distribution of grades of 1 inch lumber (excluding 6/4 resawn) marketed by Arizona lumber producers, 1959-1965.

Grade	Per cent of Boards (excluding 6/4 resawn)				Per cent of all Lumber			
	1959	1961	1963	1965	1959	1961	1963	1965
Select:								
D & Btr & Moulding	3.1	6.4	8.3	2.7	0.8	2.2	2.9	0.6
Shop:								
3 and Better	6.5	3.1	2.9	2.8	1.6	1.1	1.0	0.7
Shop Outs	-	0.3	1.3	0.5	-	0.1	0.5	0.1
Commons:								
2 and Better	2.7	1.9	3.9	9.7	0.7	0.7	1.3	2.3
3 and Poorer	87.7	88.3	82.9	84.1	22.3	30.4	28.7	19.8
Mill Run	-	-	0.7	0.2	-	-	0.2	*
Total	100.0	100.0	100.0	100.0	25.4	34.5	34.6	23.5

*Less than 0.05 per cent.

TABLE 9 Percentage distribution of widths of 1 inch lumber marketed by Arizona lumber producers, 1959-1965.

Widths (in inches)	1959	1961	1963	1965
One width specified				
2	-	-	0.4	0.4
3	-	-	0.1	-
4	1.6	3.8	1.1	3.4
6	16.6	7.6	9.9	9.2
8	30.6	20.3	18.3	26.1
10	3.7	2.0	5.2	2.8
12	17.5	35.4	37.8	39.3
Two or more widths specified				
4 and 6	0.3	-	1.3	1.5
4, 6 and 8	0.2	3.3	1.0	0.4
6 and 8	2.1	1.3	3.0	0.6
6, 8 and 10	2.4	1.6	0.4	1.7
8 and 10	3.4	0.4	1.7	1.2
8, 10 and 12	10.4	9.5	6.6	4.7
10 and 12	2.9	1.4	0.8	1.9
No width or all widths specified	8.3	13.4	12.4	6.8
Total	100.0	100.0	100.0	100.0
6 and narrowers	18.5	11.4	12.8	14.5
8 and wider	68.5	69.0	70.4	76.0
Random widths	13.0	19.6	16.8	9.5
Total	100.0	100.0	100.0	100.0

TABLE 10. Percentage distribution of grades of dimension (2 inch) marketed by Arizona lumber producers, 1959-1965.

Grade	Per cent of 2" Dimension				Per cent of all Lumber			
	1959	1961	1963	1965	1959	1961	1963	1965
Standard and Better	55.4	50.4	49.1	55.4	7.3	10.1	12.6	14.8
Utility	38.8	39.2	39.8	31.3	5.1	7.8	10.2	8.4
Economy	5.8	8.7	10.7	12.0	0.8	1.7	2.7	3.2
Shop: 3 & Better	-	-	0.4	0.4	-	-	0.1	0.1
Shop Outs	-	1.7	-	-	-	0.3	-	-
Mill Run	-	-	*	0.9	-	-	*	0.2
Total	100.0	100.0	100.0	100.0	13.2	19.9	25.6	26.7

*Less than 0.05 per cent.

TABLE 11. Percentage distribution of widths of dimension (2 inch) marketed by Arizona lumber producers, 1959-1965.

Widths (in inches)	1959	1961	1963	1965
Single width specified				
2	-	-	-	0.2
3	-	-	-	-
4	47.4	39.5	46.8	45.7
6	27.0	28.7	15.4	24.6
8	2.3	1.6	4.3	3.2
10	0.7	-	1.4	2.0
12	1.0	2.8	4.7	7.2
Two or more widths specified				
4 and 6	17.7	16.7	14.7	8.3
4, 6 and 8	3.6	3.6	2.6	1.6
6 and 8	-	1.7	2.9	0.8
6, 8 and 10	0.3	0.7	3.2	0.4
8 and 10	-	-	0.2	0.7
8, 10 and 12	-	1.6	0.5	0.9
10 and 12	-	0.4	1.1	2.4
No width or all widths specified	-	2.7	2.2	2.0
Total	100.0	100.0	100.0	100.0
6 and narrower	92.1	84.9	76.9	78.8
8 and wider	4.0	6.4	12.2	16.4
Random widths	3.9	8.7	10.9	4.8
Total	100.0	100.0	100.0	100.0

TABLE 12. Percentage distribution of thicknesses of 4/4 to 8/4 lumber (including 6/4 resawn) marketed by Arizona lumber producers, 1959-1965.

Thickness (in inches)	% of 4/4 to 8/4 Lumber				% of all Lumber			
	1959	1961	1963	1965	1959	1961	1963	1965
4/4	10.0	6.3	4.5	5.1	6.1	2.8	1.7	2.5
5/4	15.2	14.8	15.8	20.7	9.2	6.7	6.1	10.0
6/4 (incl. RS)	68.7	76.4	74.2	68.4	41.8	34.3	28.7	33.0
7/4	0.7	0.2	3.5	1.5	0.4	0.1	1.4	0.7
8/4	0.9	0.4	-	0.5	0.5	0.2	-	0.2
5/4 and 6/4	3.1	1.0	1.7	0.8	1.9	0.4	0.7	0.4
4/4 and 6/4	1.1	0.9	0.3	2.2	0.7	0.4	0.1	1.1
No specified thickness	0.3	-	-	0.8	0.2	-	-	0.4
Total	100.0	100.0	100.0	100.0	60.8	44.9	38.7	48.3

TABLE 13. Percentage distribution of thicknesses of 4/4 to 8/4 lumber (excluding 6/4 resawn) marketed by Arizona lumber producers, 1959-1965.

Thickness (in inches)	Per cent of 4/4 to 8/4 (excluding 6/4 resawn)				Per cent of all Lumber			
	1959	1961	1963	1965	1959	1961	1963	1965
4/4	15.5	11.4	8.4	7.7	6.1	2.8	1.7	2.5
5/4	23.7	27.0	30.0	31.6	9.2	6.7	6.1	10.0
6/4 (excl. resawn)	51.4	56.9	51.4	52.1	20.1	14.2	10.4	16.6
7/4	1.0	0.5	6.6	2.3	0.4	0.1	1.4	0.7
8/4	1.4	0.6	-	0.7	0.5	0.2	-	0.2
5/4 and 6/4	4.8	1.9	3.1	1.3	1.9	0.4	0.7	0.4
4/4 and 6/4	1.8	1.7	0.5	3.2	0.7	0.4	0.1	1.1
No specified thickness	0.4	-	-	1.1	0.2	-	-	0.4
Total	100.0	100.0	100.0	100.0	39.1	24.8	20.4	31.9

TABLE 14. Percentage distribution of grades of 4/4 to 8/4 lumber (including 6/4 resawn) marketed by Arizona producers, 1959-1965.

Grade	% of 4/4 to 8/4 Lumber (including 6/4 resawn)				% of all Lumber			
	1959	1961	1963	1965	1959	1961	1963	1965
Select:								
D & Btr & Moulding	9.2	7.1	9.9	13.3	5.6	3.2	3.8	6.4
Shop:								
3 and Better	32.2	33.4	34.9	38.0	19.6	15.0	13.5	18.3
Shop Outs	2.5	1.7	1.2	3.2	1.5	0.8	0.5	1.6
Commons:								
2 and Better	4.3	3.6	3.0	3.8	2.6	1.6	1.2	1.8
3 and Poorer	51.8	54.2	50.7	41.7	31.5	24.3	19.6	20.2
Mill Run	-	-	0.3	-	-	-	0.1	-
Total	100.0	100.0	100.0	100.0	60.8	44.9	38.7	48.3

TABLE 15. Percentage distribution of grades of 4/4 to 8/4 lumber (excluding 6/4 resawn) marketed by Arizona lumber producers, 1959-1965.

Grade	% of 4/4 to 8/4 Lumber (excluding 6/4 resawn)				% of all Lumber			
	1959	1961	1963	1965	1959	1961	1963	1965
Select:								
D & Btr & Moulding	14.2	12.8	18.8	20.2	5.5	3.2	3.8	6.5
Shop:								
3 and Better	49.4	60.5	66.2	56.9	19.4	15.0	13.6	18.1
Shop Outs	3.9	3.2	-	4.8	1.5	0.8	-	1.5
Commons:								
2 and Better	2.7	1.1	0.6	2.7	1.0	0.3	0.1	0.9
3 and Poorer	29.8	22.4	13.8	15.4	11.7	5.5	2.8	4.9
Mill Run	-	-	0.6	*	-	-	0.1	*
Total	100.0	100.0	100.0	100.0	39.1	24.8	20.4	31.9

*Less than 0.05 per cent.

TABLE 16. Relative importance of final buyers of Arizona lumber by per cent of board footage sold to each type, 1959-1965.

Final Buyers	1959	1961	1963	1965
Wholesalers				
Company owned distributing yard	0.7	3.1	7.1	4.8
Wholesale and broker	13.6	18.6	18.6	15.8
Total	14.3	21.7	25.7	20.6
Retailers				
Retail lumber yard or building supply	37.9	38.7	38.4	29.3
Comb. whlsle & retail	1.9	4.1	1.2	2.1
Comb. whlsle, retail & contractor	2.8	3.5	4.9	2.2
Comb. whlsle, retail & remanufacturer	1.8	2.8	2.0	5.5
Total	44.4	49.1	46.5	39.1
Wood Products Manufacturer				
Remanufacture other than sawmill	28.6	23.6	18.8	21.9
Sawmill or lbr mfr	5.2	0.3	1.7	2.9
Total	33.8	23.9	20.5	24.8
Mine	-	-	2.1	2.4
Construction contractor	1.2	0.7	0.4	1.9
Consumer	0.1	0.7	0.4	0.7
Other business firms	2.4	1.8	1.8	2.9
Government agencies	0.5	0.6	1.3	2.6
Misc. or undetermined	3.3	1.5	1.3	5.0
Total	100.0	100.0	100.0	100.0

TABLE 17. Relative importance of intermediate buyers of Arizona lumber by per cent of board footage sold through each type, 1959-1965.

Type of Buyer	1959	1961	1963	1965
Wholesaler and broker	71.3	78.2	69.3	72.9
Company-owned distributing yard	1.0	2.3	-	-
Total	72.3	80.5	69.3	72.9
Combination wholesale and retail	3.2	1.8	5.3	1.9
Combination wholesale, retail & contractor	-	-	1.1	-
Combination wholesale, retail & remanufacturer	12.6	14.9	15.6	10.0
Total	15.8	16.7	22.0	11.9
Retail lumber yard or building supply	9.5	2.5	5.3	8.8
Wood products manufacturer	1.2	-	1.7	5.4
Construction contractor	0.4	-	-	-
Other business firms	-	0.3	1.0	-
Government agencies	-	-	0.7	0.4
Miscellaneous and undetermined	0.8	-	-	0.6
Total	100.0	100.0	100.0	100.0

TABLE 18. Destination of lumber exported from Arizona, by region, in percentage of board footage exported, 1959-1965.

Region	1959	1961	1963	1965
Pacific Northwest	-	-	0.4	0.3
Pacific Southwest	8.5	7.1	10.8	9.6
Northern Rocky Mountain	-	-	-	-
Southern Rocky Mountain	20.2	22.0	24.3	22.1
Lake States	14.9	10.2	7.3	7.2
Central States	36.9	32.5	24.6	25.0
Middle Atlantic	3.3	0.3	0.5	1.9
New England	-	-	-	0.3
West Gulf	13.6	23.1	23.7	24.0
Central Gulf	2.6	4.2	6.2	4.9
East Gulf	-	0.4	0.4	-
South Atlantic	-	-	0.7	2.3
Total United States	100.0	99.8	98.9	97.6
Foreign export	-	0.2	1.1	2.4
Total	100.0	100.0	100.0	100.0

TABLE 19. Destination of lumber shipments, by region, in percentage of total board footage shipped, 1959-1965.

Region	1959	1961	1963	1965
Pacific Northwest	-	-	0.2	0.3
Pacific Southwest	6.0	5.5	7.6	7.2
Northern Rocky Mountain	-	-	-	-
Southern Rocky Mountain	42.7	39.3	46.7	41.0
Lake States	10.7	8.0	5.2	5.3
Central States	26.7	25.2	17.4	19.0
Middle Atlantic	2.3	0.3	0.3	1.5
New England	-	-	-	0.3
West Gulf	9.8	18.1	16.6	18.2
Central Gulf	1.8	3.2	4.4	3.7
East Gulf	-	0.3	0.3	-
South Atlantic	-	-	0.5	1.7
Total United States	100.0	99.9	99.2	98.2
Foreign export	-	0.1	0.8	1.8
Total	100.0	100.0	100.0	100.0

TABLE 20. Comparison of types of lumber, by general quality classifications, exported from and retained in Arizona, 1965.

Grades	% of All Lumber Retained in Ariz.	% of All Lumber Exported from Ariz.	% of All Arizona Lumber
Selects	6.3	7.4	7.0
Shop			
3 and Better	22.0	18.1	19.1
Shop Outs	1.8	1.6	1.7
	23.8	19.7	20.8
Commons			
Boards			
2 and Better	4.3	4.0	4.1
3 and Poorer	23.0	45.5	40.1
	27.3	49.4	44.2
2 inch Dimension			
Standard and Better	23.1	12.1	14.8
Utility	6.1	7.9	7.4
Economy	4.3	3.2	3.4
Mine Lagging	3.8	-	0.9
	37.3	23.2	26.5
3 inch & thicker Dimension			
Mine lagging	2.7	0.1	0.7
Other grades	2.6	0.2	0.8
	5.3	0.3	1.5
Total	100.0	100.0	100.0

APPENDIX E

LUMBER SIZES

APPENDIX E

LUMBER SIZES

Thickness		Widths		Lengths
Nominal Size Inches	Dressed Size Inches	Nominal	Dressed	
FRAMING, TIMBERS AND STRUCTURAL				
2	1-5/8	4	3-5/8	6 ft &
3	2-5/8	6	5-1/2	longer in
4	3-5/8	8	7-1/2	multiples
6	5-1/2	10	9-1/2	of 1 or
8	7-1/2	12	11-1/2	2 ft
10	9-1/2			
12	11-1/2			
SELECTS (FINISH) AND COMMONS (BOARDS)				
1 (4/4)	25/32(4/4)	4	3-5/8	6 ft &
1-1/4(5/4)	1-5/32 (5/4)	6	5-1/2	longer in
1-1/2(6/4)	1-13/32(6/4)	8	7-1/2	multiples
1-3/4(7/4)	1-19/32(7/4)	10	9-1/2	of 1 or
2 (8/4)	1-13/16(8/4)	12	11-1/2	2 ft
2-1/2(10/4)	2-3/8 (10/4)	Over 12	Off 1/2	
3 (12/4)	2-3/4 (12/4)			
4 (16/4)	3-3/4 (16/4)			
FACTORY AND SHOP LUMBER				
1 (4/4)	25/32(4/4)	5 and	See	6 ft &
1-1/4(5/4)	1-5/32 (5/4)	wider	rough	longer in
1-1/2(6/4)	1-13/32(6/4)	(4" & wider	sizes	multiples
1-3/4(7/4)	1-19/32(7/4)	in 4/4 No. 1	not	of 1 or
2 (8/4)	1-13/16(8/4)	Shop & 4/4	edged	2 ft
2-1/2(10/4)	2-3/8 (10/4)	No. 2 Shop)		
3 (12/4)	2-3/4 (12/4)			
4 (16/4)	3-3/4 (16/4)			

Lumber Sizes (continued)

Source: Buyers' Manual (Portland, Oregon: Western Wood Products Association, 1965), p. 7.

APPENDIX F

FOREST SPECIES IN ARIZONA

APPENDIX F

FOREST SPECIES IN ARIZONA

Douglas Fir

Botanical classification. Douglas Fir was discovered and classified by botanist David Douglas in 1826. Botanically it is not a true fir but a species distinct in itself known as Pseudotsuga taxifolia. In the Western Woods Region, Douglas Fir trees are found at elevations of 1500 feet and higher; they grow to maximum diameters of more than seven feet and heights of 200 feet.

Properties. Douglas Fir is straight grained and moderately heavy. Although classed as a resinous wood the amount of resin is limited. The sapwood ring is almost pure white and very narrow. Heartwood is orange-red and the color contrast between springwood and summerwood is quite distinct.

The wood weighs 31 pounds per cubic foot and specific gravity is .44 at 12 per cent moisture content. Pound for pound, Douglas Fir is one of the strongest of the softwoods. Its load bearing capacity equals many mild steels and, of course, it is considerably lighter in weight. Its strength makes it the nation's first-line wood for structural purposes.

Douglas Fir ranks approximately midway among all commercial softwoods in nail-holding ability. Safe resistance to withdrawal of eight-penny nails driven perpendicular to the grain into seasoned stock is 28 pounds per lineal inch of length, while other softwoods range from 17 to 39 pounds. Blunt-pointed or ordinary common nails are recommended because Douglas Fir, of relatively high specific gravity, tends to split more readily than softer textured woods.

Uses. Combining raw strength with delightful grain configuration, Douglas Fir is suitable for the heaviest of structural work to the finest of high grade finish purposes and for the many utility uses in between.

Its most popular use in home construction is in framing--for posts, beams, joists, studs and rafters--comprising the bones of the house. Properly seasoned, it

Douglas Fir (continued)

stays straight and, with its strength, stiffness and nail-holding ability, provides superior dollar-for-dollar value in this most important feature of the structure.

Heavy construction. Douglas Fir stands unsurpassed for heavy structural timbers. It is one of the strongest woods per pounds of weight in the softwood field. Where strength is the primary factor, Douglas Fir meets all requirements, and its straightness, ease of fabrication and availability in a wide range of sizes and stress grades furnish bonus qualities.

For posts, beams, stringers, joists, bracing, flooring and decking, rafters, roof decking, and for the many different members which make up trusses for factory and warehouse roofs, it is the perfect heavy duty wood.

Source: Folder P5-11 (Portland, Oregon: Western Wood Products Association, n.d.).

Engelmann Spruce

Botanical classification. The scientific name of Engelmann Spruce is Picea engelmanni. Botanically the species is closely related to Eastern White Spruce and Sitka Spruce, although normally the trees are smaller and produce more of the tight-knotted boards than do the very large Sitka Spruce trees which grow along the north Pacific coastline.

The average Engelmann Spruce measures about two feet in diameter and 120 feet in height, though in most favorable locations they attain diameters of six to seven feet with a maximum height of approximately 180 feet. The species sometimes is found in pure stands but more often it grows intermingled with Douglas Fir, Larch, Ponderosa Pine, Idaho White Pine, White Fir and Inland Red Cedar.

Properties. Engelmann Spruce is extremely light, nearly white in color, with a faint growth ring. It weighs 39 pounds per cubic foot in a green state and 23 pounds dried to 12 per cent moisture content, making it one of the lightest of the commercially important softwoods. Specific gravity is .33 at 12 per cent moisture content. Volumetric shrinkage of the species is 5.2 per cent when dried from a green condition down to 12-15 per cent moisture content.

Engelmann Spruce (continued)

Uses. Engelmann Spruce has a wide range of uses, ranging from rough construction to fine interior finish and specialty products. Better grade boards are used for flooring, ceiling, siding, roof and barn boards and lower grades are employed as concrete forms, temporary enclosures and other general construction articles. Suggested uses: siding; sheathing and subflooring; general construction; paneling and interior finish; farm; boxes, crates and containers; furniture; industrial.

Source: Folder P5-7 (Portland, Oregon: Western Wood Products Association, n.d.)

Ponderosa Pine

Botanical classification. Ponderosa Pine (Pinus ponderosa) is one of the soft-textured pines--a group distinct from the southern yellow pines which are heavier, harder and pitchier and have widely different values and uses. The soft pine species of commercial importance in the United States, in addition to Ponderosa Pine, include Idaho White Pine, Sugar Pine, and Lodgepole Pine.

Botanically not a true white pine, Ponderosa Pine wood is classified by authorities as generally similar in properties to the white pines.

The Ponderosa Pine trees average from 125 to 185 feet in height. In favored locations it exceeds 200 feet. It grows to diameters of three to six feet with occasional specimens up to eight feet. Bark is a distinctive yellow-brown and on mature trees is arranged in large plates.

Properties. Ponderosa Pine is a soft-textured wood with typically straight, close and uniform grain, unexcelled for smoothness and fine appearance when surfaced, and easy to work with hand or machine tools.

The wood is light in color, varying from creamy white to straw. After dressing it presents delicately figured grain, Specific gravity at 12 per cent moisture content is .40 within the .31-.58 range of all softwoods. At the same moisture content, the mean weight of Ponderosa Pine is 28 pounds per cubic foot, compared to the 23-41 pound variance among all softwoods.

The wood has long been noted for its ability to

Ponderosa Pine (continued)

take and hold nails and other fastenings without splitting or without extra care in fastener selection. It is an extremely workable wood, respected by the woodworking profession for the ease with which it is fashioned into fine moulding and other intricate detail work.

Uses. Ponderosa Pine is generally recognized as the most versatile wood found in abundance in North America. Its uses range throughout every phase of the light construction field. It is extremely valuable to general industry and it is widely used in the woodworking field for fabrication into architectural woodwork, furniture and specialty products. Suggested uses: siding, sheathing and subflooring, light framing, paneling and architectural woodwork, furniture, boxes and crates, and wood novelties and specialty cuttings.

Source: Folder P5-2 (Portland, Oregon: Western Wood Products Association, n.d.).

White Fir

Botanical classification. Abies Concolor--found in southern Oregon, California, Nevada, Utah, Colorado, Arizona, New Mexico, southern Idaho and Wyoming.

These true firs normally grow in mixed stands with other commercial species although pure stands sometimes occur.

As a group, White Firs are evergreen trees with peculiarly conical, often very spire-like, dense crowns of heavily foliaged branches. Mature trees vary in height from 150 to 275 feet and in diameter from 18 inches to nearly four feet.

Properties. The lumber of White Fir is non-resinous and fine-textured. Springwood is flat white in color and summerwood has a slight reddish-brown tinge. Contrast between heartwood and sapwood is so slight as to be not readily distinguishable.

At 12 per cent moisture content, White Fir weighs 27 pounds per cubic foot, compared to the 23-41 pound variance among all softwoods. Specific gravity at the same moisture content is .38, within the .31-.58 range of all softwoods.

White Fir (continued)

Uses. White Fir is one of the most versatile softwoods in America. It is widely used in residential and light commercial construction, particularly for framing, and is extremely valuable to general industry as a general utility and specialty material. Suggested uses: siding; sheathing and subflooring; framing; roof decking; architectural woodwork and paneling; concrete forms; planking, posts, stringers and timbers; industrial flooring; box shook and crating.

Source: Folder P5-6 (Portland, Oregon: Western Wood Products Association, n.d.)

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